COLONY AND PROTECTORATE OF KENYA.

REPORT OF THE PROCEEDINGS

OF THE

FIFTH PAN-AFRICAN VETERINARY CONFERENCE.

CONVENED BY

H. E. THE GOVERNOR, SIR ROBERT T. CORYNDON, K.C.M.G.

HELD AT NAIROBI FROM 6TH TO 14TH APRIL, 1923.

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Back Row (left left to right): Captain B. A. Jarvis, R.A.V.C. (Sudan); Captain R. H. Knowles, R.A.V.C. (Sudan); J. A. Griffiths (Nyasaland).
Middle Row (left to right): J. T. C. Bradshaw (Kenya), Interpreter; H. E. Hornby (Tanganyika); U. F. Richardson (Uganda); Dr. P. R. Viljoen (South Africa); J. Walker (Kenya); F. J. McCall (Tanganyika); E. Hutchins (Uganda); H. H. Bressey Edwards (Kenya), Secretary.
Bottom Row (left to right): Dr. N. B. Botelho (Portuguese East Africa); W. M. Power (Natal); R. E. Montgomery (Eastern Africa), Chairman; W. Kennedy (Kenya); Vet. Major Paul Tissié (Madagascar).

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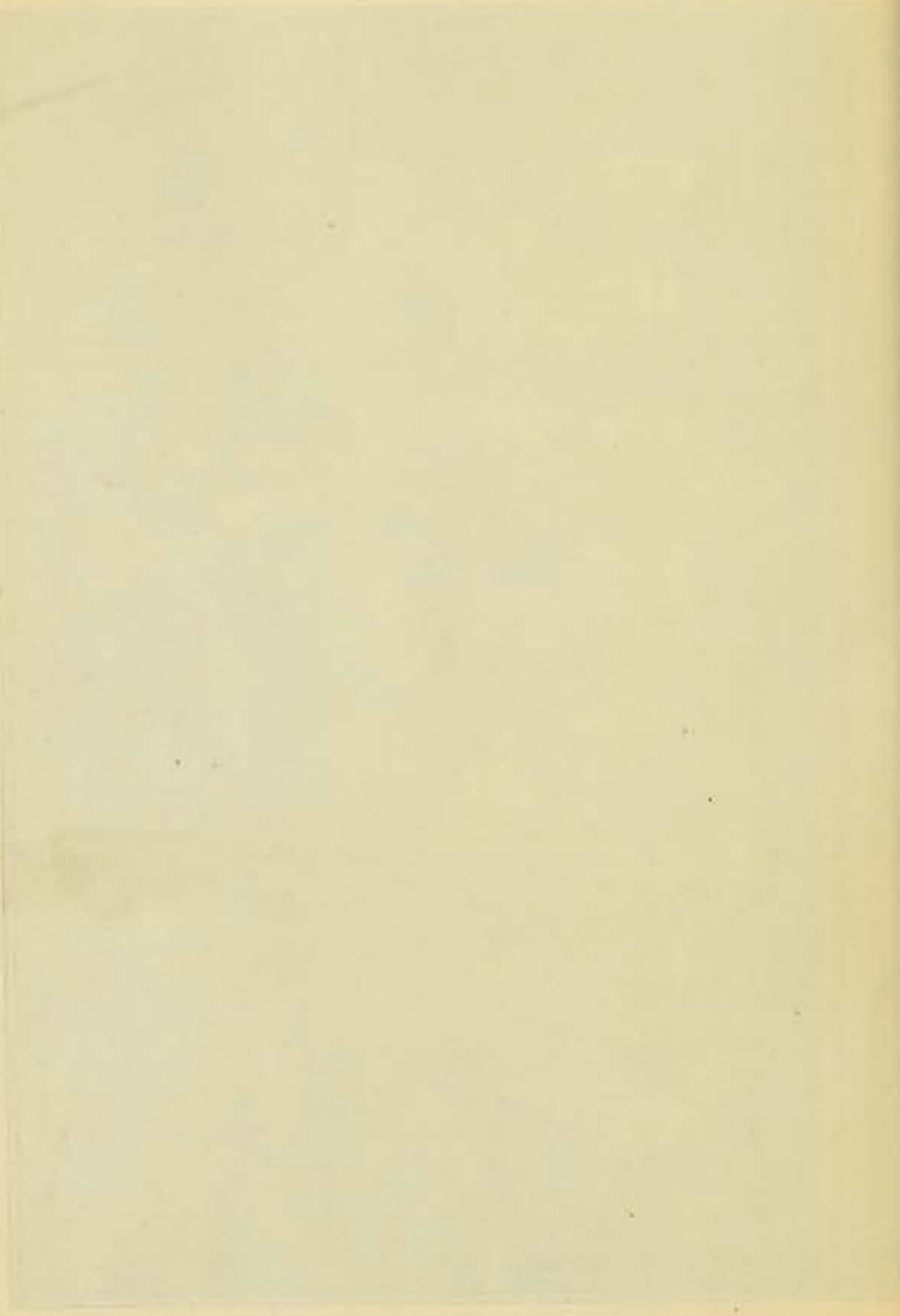

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COLONY AND PROTECTORATE OF KENYA.

REPORT

OF THE

PAN-AFRICAN VETERINARY CONFERENCE.

HELD AT GOVERNMENT HOUSE, NAIROBI, ON FRIDAY, 6TH APRIL, 1923, AT 11 A.M. AND FOLLOWING DAYS.

PRESENT.

Name.	*Designation.*
Messrs.	
R. EUSTACE MONTGOMERY	... Veterinary Adviser, Kenya, Uganda, and Tanganyika.
W. KENNEDY ...	... Chief Veterinary Officer, Kenya Colony.
J. WALKER ...	... Chief Veterinary Research Officer, Kenya Colony.
W. M. POWER ...	... Senior Veterinary Officer, Natal.
DR. P .R. VILJOEN . .	... Sub-Director of Veterinary Education and Research, Pretoria.
B. A. JARVIS (CAPT. R.A.V.C.) ...	Senior Veterinary Inspector, Sudan.
RICHARD HALL KNOWLES (CAPT. R.A.V.C.) ...	... Veterinary Bacteriologist, Sudan.
E. HUTCHINS ...	... Chief Veterinary Officer, Uganda.
U. F. RICHARDSON ...	... Veterinary Pathologist, Uganda.
VETERINAIRE MAJOR PAUL TISSIE...	Chef du Laboratoire Veterinaire, Tananarive, Madagascar.
DR. JOAO BAPTISTA BOTELHO ...	Chief Veterinary Officer, Portuguese East Africa.
F. J. MCCALL	Chief Veterinary Officer, Tanganyika Territory.
H. E. HORNBY	Veterinary Pathologist, Tanganyika Territory.
J. A. GRIFFITHS ...	... Chief Veterinary Officer, Nyasaland.

Messrs. H. H. BRASSEY-EDWARDS, Senior Veterinary Officer, Kenya, as Secretary, and J. T. C. BRADSHAW, Veterinary Research Officer, Kenya, as Interpreter.

DR. P. R. VILJOEN proposed and Mr. W. M. POWER seconded that Mr. R. EUSTACE MONTGOMERY take the Chair. This was carried unanimously.

Mr. R. EUSTACE MONTGOMERY, on taking the Chair, thanked the Delegates for the honour and proposed the principles under which the Conference should be held.

These were that the meetings shall so far as possible take the form of a round-table gathering, Delegates being permitted freedom of speech and questioning. A Delegate would be nominated for each item of the Agenda decided upon whose duty it would be to open and to close the discussion upon that subject.

The hours of meetings were decided as 9 a.m. to 12.30 p.m., and 2.30 p.m. to 4 p.m. The place of session being in the Council Chamber of Government House, Nairobi.

Arrangements would be made so far as possible to ensure full verbatim reports of the transactions being available to speakers for correction on the following day.

The Chairman pointed out that this was the first Pan-African Veterinary Conference at which subjects of an industrial and economic nature affecting livestock had been definitely inserted in the Agenda.

The Draft Agenda (see Appendix A) circulated by His Excellency Sir Robert T. Coryndon, K.C.M.G., Governor of Kenya, in his letter of invitation to other Governments was then considered, and the following Agenda was decided upon, together with the names of the Delegates to introduce the subjects. It was agreed that all resolutions arising out of the Agenda shall be tabled until the conclusion of the Conference when they can be considered with a greater sense of proportion.

AGENDA.

		Reporter.
(a)	*Specific Animal Diseases.*	
1.	Pleuro-pneumonia	Mr. J. Walker.
2.	Rinderpest	Mr. H. E. Hornby.
3.	East Coast Fever	
	Tick destruction	
	Tick-borne diseases	Mr. W. M. Power.
4.	Trypanosmiasis	
	Tsetse bionomics	Mr. U. F. Richardson.
5.	Horsesickness	Dr. P. R. Viljoen.
6.	Anthrax	do.
7.	Blackquarter	do.
8.	Gallamziekte	do.
9.	Contagious Abortion	Mr. W. Kearney. (by invitation)
10.	Avian diseases	do.
11.	Helminthiasis	Mr. H. E. Hornby.
12.	Skin Diseases	Mr. F. J. McCall.
13.	Plant Poisoning	Dr. P. R. Viljoen.
14.	Ulcerative Lymphangitis	Vet. Major Paul Tissié.
15.	Swine Fever	Mr. R. E. Montgomery.
16.	Rabies	Mr. W. Kennedy.
(b)	*Pathological Research*	Mr. R. E. Montgomery.
	Dominant diseases in each country.	
	Co-ordination preventing duplication.	
	Exchange of Reports and Memoranda.	
(c)	*Disease Control.*	
1.	Administrative system	Capt. B. A. Jarvis (R.A.V.C.).
2.	Use of natives for Intelligence purposes ...	Mr. J. A. Griffiths.
3.	Legislation and punishments	Mr. W. Kennedy.
(d)	*Grazing and Water Facilities.*	
	Botanical and Entomological Surveys ...	Mr. W. Kennedy.
(e)	*Stock Improvement.*	
	Eugenics.	Mr. A. G. Doherty (by invitation)
	Selection and registration of Sires	do.
(f)	*Stock Economics.*	
1.	Animal taxation	Capt. B. A. Jarvis (R.A.V.C.).
2.	Milk products	Mr. E. Hutchins.
	Ghee production	do.
3.	Meat and meat products	Vet. Major Paul Tissié.
	Hides and skins	do.
	Wool and hair	do.
4.	Animal transport	Mr. F. J. McCall.

The afternoon session opened at 2.30 p.m., when His Excellency Sir Charles Bowring, K.B.E., C.M.G., kindly attended to open the Conference. Members of the Government, Heads of Departments, Foreign Consuls and other interested gentlemen were present.

The Chairman in introducing His Excellency expressed pleasure in having Sir Charles Bowring present to formally declare the Conference open.

Sir Charles Bowring said: In the name of the Government of Kenya I extend to you, the Members of this the Fifth Veterinary Pan-African Conference, a very hearty welcome to our territory. It is 20 years since the first Conference of this nature was held at Bloemfontein and it is a matter of profound satisfaction to this Government that Nairobi should have been selected as this year's venue. I should like to express my very great regret that Sir Robert Coryndon is not here to greet you. It is to him that is due the movement initiated a few years ago for more intensive conservation of stock in Eastern Africa and his great personal interest in veterinary activities is well known.

I understand that if it had not been for the late war this Conference would have been held in Eastern Africa in 1915 or 1916. So far at least as this Colony is concerned I think it is fortunate that the Conference has been postponed until a time when, after experiencing the transitory delights and optimism of a period of boom, we have experienced the other extreme in our financial position and are now emerging from the recent era of depression with our financial affairs readjusted or in course of adjustment as necessity dictated.

It is with very great pleasure that I am able to record the fact that this financial adjustment has kept our Veterinary Department as a whole, with its activities, not unduly curtailed. Indeed, by a rearrangement of staff it has been possible to give effect to a new policy for devoting special attention to the vast possibilities, from a stock point of view, of the native reserves.

A special section appears in our present budget for this service and I hope and believe that in future years it will be possible so to strengthen this branch as to ensure the conservation and conversion to a commercial proposition of the 3,000,000 head of cattle which are owned by the various tribes in this Colony and Protectorate.

This number does not, of course, include the cattle owned in other parts of Eastern Africa which, in British territories alone, amount to some 7,000,000 head, and a common policy by the several Governments who are interested with the administration of this large portion of the African Continent will ensure a vast increase in the world's trade which is represented by this potential asset. To such uniformity, I trust, your deliberations will tend.

We have also to congratulate ourselves that, in spite of the financial stringency, we have been able to provide in the Budget for the current year for our share of the expenses of a Veterinary Adviser for the British Group of Dependencies in Eastern Africa, and that we have secured in the person of your Chairman an officer whose world-wide reputation and great knowledge of veterinary science so pre-eminently fits him for the post.

I notice that in addition to your Chairman, two of your Members have participated in past Veterinary Conferences, Mr. Power having been a Member of the Pretoria Conference of 1909 and Signor Botelho of the Bulawayo Conference of 1918.

I am sure that their presence here to-day will be of the greatest assistance to you in transacting the business before you.

Africa bears an honoured name in research work. The Wellcome Laboratories in the north and Onderstepoort in the south are well known, and we in the middle of the continent have an institution at Kabete which is unquestionably destined to perform similar great services for Eastern Africa.

The recently established School of Veterinary Science in the Union of South Africa is another step in this important factor in colonisation. It is to be regretted that for various reasons representatives have not been able to attend from the Congo, Italian Somaliland, Egypt, the West African Colonies or Southern Rhodesia, but it is satisfactory to see so many of the territories represented from the Sudan in the north to the Union in the south and I extend a special welcome to your colleagues from Madagascar and Portuguese East Africa.

I notice that your Agenda is a long one, and that it includes subjects of a scientific, administrative and industrial character. By considering all these aspects at one time, and keeping the importance of each in mind, I am confident that your deliberations will prove to be of the utmost value.

I now declare your Conference open and wish it every success with the firm conviction that your deliberations will be fruitful of much good not only to all stockowners, but to all those enterprises, and there are many, which to a greater or lesser degree are dependent on the conservation of stock.

Mr. W. M. Power: I have the honour to propose a vote of thanks to His Excellency on behalf of the Delegates for coming here to open our Conference to-day. It is certainly a matter for congratulation and very encouraging when the Governor of the Colony takes such an interest in the work we are dealing with that he comes personally to open the Conference. It is most encouraging to those engaged in the very difficult task of investigating diseases in Africa when heads of Governments show such interest in the work. Africa has many disease problems and I am afraid before visiting East Africa I did not then fully appreciate the difficulties. We have many difficulties in South Africa, but I believe yours are greater. Conferences such as these could only put forward recommendations and it was sometimes a question as to whether the Governments concerned could find the funds to put those recommendations into operation.

Mr. W. Kennedy expressed great pleasure in seconding the vote of thanks proposed by Mr. Power to His Excellency for opening the Conference.

His Excellency then met personally all the Delegates and afterwards together with the Public, withdrew from the Meeting.

(A) SPECIFIC ANIMAL DISEASES.

(1) Pleuro-pneumonia Contagiosa Bovum—(Lung Sickness).

Mr. J. Walker (Chief Veterinary Research Officer, Kenya Colony): I am pleased to have this opportunity of opening the debate on Bovine Pleuro-pneumonia, and I propose with your permission to deal more particularly with the research work carried out in connection therewith at the Kabete Laboratory during the course of the last two or three years.

Shortly after my arrival in this Colony in 1918 on appointment to the post of Veterinary Pathologist, I was instructed to confirm, or otherwise, the specific nature of the disease. At that time Pleuro-pneumonia was known to exist in the Masai Reserve, and a few outbreaks had been reported on European farms in the settled areas of the Colony, the origin of which had been traced to the illicit movement of infected cattle from the Masai Reserve.

The conclusions arrived at by some previous workers were that the symptoms and spread of the disease in this Colony were similar to those of Bovine Pleuro-pneumonia, but the pathological changes observed on post-mortem examination did not always correspond with the classical description given in text-books, as, for instance, it was frequent to find:—

(1) No characteristic marbled appearance.

(2) Little or no exudate in the pleural cavity.

(3) Firm fibrous adhesions between the affected lung and chest wall.

(4) A sequestrum or a cavern.

In some instances no sequestrum existed. Transmission and culture experiments had not given conclusive results and a difficulty was experienced in confirming the diagnosis. As soon as an opportunity occurred transmission and culture experiments were carried out, and the histo-pathological changes were studied, with the result that the diagnosis of Bovine Pleuro-pneumonia was confirmed.

In some instances preventive inoculation with field virus had been resorted to, but owing to the difficulty in controlling the reactions the results were not altogether satisfactory.

Fresh outbreaks occurred on European farms and owing to the difficulty experienced by Veterinary Officers in obtaining field virus we were asked to prepare and issue a virus for immunisation purposes.

The laboratory apparatus required for the preparation of a pure culture vaccine not being at that time available, it was decided to maintain at the laboratory a strain of "field virus" by passage through susceptible cattle.

Virus was collected from the local swelling which developed at the site of inoculation behind the shoulder. This was mixed with glycerine in the proportion of one of glycerine to four of virus, the dose being 1 c.c. inoculated subcutaneously in the tip of the tail.

The results of inoculation in the field with virus prepared by this method were not always satisfactory. A difficulty was experienced in controlling the reactions and a serious mortality sometimes followed its use.

Moreover the method was costly, and since it was impossible to predetermine the size of the reaction, which would develop at the site of the inoculation, supplies of virus could not be guaranteed, unless a number of cattle were maintained for virus production purposes.

On the arrival of the necessary laboratory apparatus a pure culture vaccine was prepared, the original and first and second generation sub-cultures were as virulent as the virus from which they originated, but it was subsequently found that the virus became fixed in virulence in subsequent sub-cultures and when inoculated to susceptible cattle mild reactions, with little or no tendency to extend up the tail, resulted. The mortality was approximately 1 in 1,000.

In order to determine the resistance conferred by pure culture vaccine inoculation a number of inoculated and non-inoculated cattle were herded and bomaed with a mob of several hundred infected native cattle in the Masai Reserve amongst which deaths were occurring daily from pleuro-pneumonia.

Various lots of cattle were exposed to a high degree of infection during the period 15th September, 1921 to the 3rd April, 1922.

A Stock Inspector was detailed to supervise the field experiment and instructed to report should any cases of Pleuro-pneumonia, or suspected Pleuro-pneumonia, occur amongst the experimental animals. Several cases of Pleuro-pneumonia were confirmed amongst the experimental animals. Owing to the shortage of grazing and water the native-owned infected herd were removed on the latter date, the surviving experimental cattle were slaughtered three months later and inspected by me, with the result that in a few cases Pleuro-pneumonia was found on post-mortem, to exist, but had escaped observation in the living animal.

The results of the exposure experiment were as follows, viz.:

Non-inoculated Cattle. Total number exposed 34.

Total number contracted pleuro-pneumonia 14=41%.

Inoculated Cattle.

(*a*) reacted to inoculation.

Total number exposed 75.

Contracted pleuro-pneumonia—Nil.

(*b*) non-reactors to inoculation.

Total number exposed 19.

Contracted pleuro-pneumonia 1=6.6%.

No difficulty is experienced in preparing supplies of pure culture vaccine to meet all demands.

The directions for use of the vaccine are as follows, viz.:—

The original inoculation to be made in the tip of the tail.

Animals which fail to react, to be reinoculated in the tail, on the 14th day after the date of the original inoculation.

Animals which react to the original tail inoculation, to be reinoculated "behind the shoulder" on the 14th day after the date of the original inoculation, animals which fail to react to the first and second tail inoculation to be reinoculated "behind the shoulder."

Experiments and observations in connection with the course and termination of the disease and the infectivity of so-called recovered animals—(old lungers).

In 1918, the speaker inspected the carcases of 280 cattle which were slaughtered in the Masai Reserve by the military for food consumption. They were purchased by the military in various parts of the reserve and were with few exceptions in good condition.

A striking feature of these observations being the number of cattle, approximately, 60% which had recovered and showed no evidence of existing infection.

The most constant post-mortem appearance in recovered animals was a pleuritis fibrosa, the previously affected lung being firmly adherent to a portion of the chest wall.

An opportunity occurred in 1922 of carrying out further observations on cattle from the Nandi Reserve.

A number of suspected infected cattle were selected and railed to the laboratory for experiments in connection with the serum diagnosis of pleuro-pneumonia. These cattle were subsequently slaughtered, material (sequestrum) was collected from a number which showed lesions on post mortem, and inoculated subcutaneously behind the shoulder to susceptible cattle. It was found that:—

(1) The sequestrum did not always transmit pleuro-pneumonia.

(2) That in a percentage of animals which contract pleuro-pneumonia, the existence of the disease escapes observation during life, and recovery occurs.

(3) That a percentage make a recovery and are no longer a source of infection, no sequestrum being found on post-mortem. It is usual to find in these cases a pleuritis fibrosa and collapse of the previously affected lung, or a portion thereof.

(4) Virus was found to exist in the lesions of cattle which were known to have contracted pleuro-pneumonia about 12 months previously, on the other hand material collected from cattle known to have been infected for a similar period did not transmit pleuro-pneumonia.

The period for which the virus exists in the lung of an affected animal would seem to depend on the fate of the lesion. The indications are: (i) that in infected herds a number of recovered animals exist which are no longer a source of infection; (ii) that a percentage contract the disease which escapes detection; (iii) a percentage of infected animals remain a source of infection, and are responsible for its spread, particularly to the young susceptible stock, if the outbreak is uncontrolled.

South Africa was declared officially free of pleuro-pneumonia in 1914. The regulations provided for the quarantine, inoculations of incontacts and slaughter of visibly affected animals, and I believe that South Africa is unique in being the only country in which the disease has been eradicated by these means; it is inexplicable to me that the above-mentioned measures alone were responsible. I am inclined to think that natural recoveries played a greater role than was suspected.

Serum diagnosis experiments. It is well recognised that the so-called recovered animals (old lungers) are difficult to detect by clinical means, and that in some cases at least they are responsible for the spread of infection. During the last year or two the speaker has carried out investigations with a view to the introduction of a serum diagnosis test.

The difficulty of obtaining and maintaining supplies of small animals, guinea pigs and rabbits, entered into consideration, and it was decided to investigate whether the conglutination reaction could not be applied to the serum diagnosis of Bovine Pleuro-pneumonia.

Recent workers, Titze, Gieze, and Heslop, claim to have discovered a method of serum diagnosis by the complement fixation method, and the latter has recorded that the agglutination reaction has given more satisfactory results and is easier of application. Since Bordet and Gay found that normal cattle serum heated to 58° F. in the presence of horse serum (complement) conglutinated washed red cells, the reaction has been applied for the serum diagnosis of some human and animal diseases, more particularly for the serum diagnosis of glanders, the anti-body in the presence of the corresponding antigen fixing the complement, with the result, that no conglutination occurs which indicates infection.

A number of tests with sera of infected and clean cattle have been carried out and the results confirmed on post-mortem examination. Satisfactory results have been obtained and the test is being put to a practical use to determine the existence or otherwise of bovine Pleuro-pneumonia in trade cattle prior to their being permitted to enter the settled areas from native reserves. The indications are that the test can be applied to determine the immunity conferred by inoculation; our knowledge of which has hitherto been obtained by exposing inoculated cattle to natural infection, or by reinoculating animals which have previously reacted.

It has been stated by some investigators that the immunity conferred depends on the intensity of the reaction, and by others that a small reaction is sufficient to produce immunity, but it is not quite clear to me how these conclusions were arrived at. The results of serum tests of inoculated cattle show that more specific fixation of complement occurs in cattle which have given a well-marked reaction to inoculation, in comparison with those giving slight reactions, which would seem to indicate the existence of a higher anti-body unit in the former.

Mr. F. J. McCall. Were the animals which were sent to the Masai Reserve from the Kabete Laboratory? What number of inoculated cattle were included?

Mr. J. Walker: Yes. About 90 head.

Mr. H. E. HORNBY. Has there not been other work of this kind (Serum diagnosis test) carried out by an Australian?

Mr. J. WALKER. Yes. The literature records some complement fixation methods devised by Heslop. Heslop also records a successful agglutination method, in which the tubes and their contents remain in the incubator for 48 hours, and the results are read on the opacity or otherwise of the contents of the tubes and the deposit in the tubes. Our experience has been that you get a deposit in the normal sera tubes incubated for 48 hours.

Mr. H. H. BRASSEY EDWARDS: At the request of Mr. Walker, this gentleman related his experiences. He said:—

"My first extensive operation in the field with Pleuro-pneumonia was done with field virus in herds numbering about 9,000 head. The virus for inoculation was obtained from behind the shoulder from a laboratory animal. It was found in the tail inoculation in 20% of cases the reactions extended up the tail, along the back and in some instances surgical operations were performed to prevent a general spread. The mortality was approximately 10%. Following upon this Mr. Walker gave us a prepared vaccine of a pure culture which was used in inoculations in the Kikuyu Reserve. The first result of the reactions of the inoculation of the prepared vaccine in the tail was small and difficult to judge, which necessitated a second or third inoculation before we could exclude all the non-reacting animals, which amounted to about 3%. Those animals that did not react were re-vaccinated with a strong fresh virus with no results. The mortality from the tail inoculation with this pure culture vaccine was one in 1,000.

"Afterwards I carried out inoculations in the Lumbwa Reserve on approximately 10,000 head of cattle. I inoculated the culture vaccine on this occasion directly behind the shoulder. In this reserve there was a very high percentage of infection. The total percentage of reactions from inoculation was 23%. The reactions were very easy to judge ranging from about the size of a walnut. Twenty-five per cent of the total number gave good reactions followed by immense swellings which extended down the chest wall and under the body. A mortality of four per cent was directly due to extensive swellings. I understand that the culture vaccine used was a 44th sub-culture. Transport animals vaccinated in 1920 were vaccinated again behind the shoulder in the present year, and without exception there was not the slightest sign of a reaction. I consider the revaccination in the light of an immunity test."

Mr. H. E. HORNBY: What is the longest time after being sent out that the vaccine may be used? I ask this because two lots received from Mr. Walker failed to give any reaction, after a fortnight's journey in hot weather. That the virus was not dead was shown by successful sub-cultures, although they also failed to give rise to any reaction when I inoculated behind the shoulders of susceptible beasts.

Mr. H. H. BRASSEY EDWARDS: Culture vaccine was sent from Kabete to Lumbwa Station, over 150 miles, then carried 100 miles by runner, and gave excellent results 10 days after issue.

Mr. W. M. POWER: Were the injections in the tail or shoulder?

Mr. H. H. BRASSEY EDWARDS: Behind the shoulder.

Mr. F. J. MCCALL: Veterinary Officer Hayes, Tanganyika Territory, had several batches of Mr. Walker's vaccine, and, except in a few cases, he failed to get any reaction. The first vaccination was in the tail and subsequently in the shoulder.

Mr. H. E. HORNBY: Did not Mr. Chase, Bechuanaland, have good results in the field with field virus?

THE CHAIRMAN: Yes. In 1915 and 1916 I think, but later was less successful.

Mr. W. M. POWER remarked about South Africa. No cases of lung sickness there for several years with the exception of a case brought in from Bechuanaland last year which was dealt with by slaughter. Mr. Walker has referred to eradication of the disease in South Africa. It is perfectly true, nothing else was responsible for its disappearance but the methods employed, viz.: inoculation, destruction of visibly infected animals and quarantine. During and after the Boer War we had a lot of lung sickness in South Africa. Had many unsatisfactory experiences of swellings and mortality. The country was pretty well cleared up in a few years by a general system of inoculation and quarantine. We used to notice in those days on farms where cattle were inoculated that we got outbreaks from calves born and not inoculated. We attributed that to "old lungers" spreading infection. There was no means of ascertaining which were sources of infection and which not, but it was recognised that all "old lungers" may not be capable of spreading the disease. Legislation to destroy all infected animals and pay compensation was obtained and this assisted very largely in the campaign against the disease.

The period of six weeks quarantine was too short and it was increased to three months.

Mr. W. KENNEDY: Might I ask if you reinoculated cattle which did not react or if only one inoculation was carried out.

Mr. W. M. POWER: Only one inoculation. Animals in those days sometimes suffered from too severe reactions, but where there were no traces of reactions they were reinoculated. The majority of cattle did react.

THE CHAIRMAN referred to the disease in Uganda, which was first diagnosed a few years ago, and since has become scattered throughout the Eastern Province. Over 300 centres of infection have been recorded in the past three years, of which only about 40 remain to-day, the remainder having been suppressed. Operations have been conducted on as intensive a scale as possible, as of all diseases Pleuro-pneumonia is one demanding mass effort over a big area, otherwise it works round. Unless the present supervision is continued the condition will recrudesce and once firmly established will be almost impossible of eradication which at the present time appears hopeful.

The speaker referred to the use of field virus, which on account of transport difficulties was more widely employed than laboratory culture. It was found in practice that the addition of 25% glycerine was beneficial, the mixture remaining 10 days prior to use. Five per cent carbolic acid was also added. This mixture could be employed up to a month after collection and was still found good.

One officer had reported that following vaccination of an infected herd, the action of inoculation was to hasten the deaths of those already infected.

Mr. H. H. BRASSEY EDWARDS: In a large mob of infected cattle which were vaccinated with 5 c.c. culture vaccine only one in 20 died.

Mr. W. KENNEDY gave a brief history of Pleuro-pneumonia in Kenya Colony. From native evidence Pleuro-pneumonia was widespread throughout the Colony 35-40 years ago, but Rinderpest came along later and helped considerably to stamp it out. In 1906 about six infected centres were located in different parts of the country and apparently they had no connection with one another. The staff at that time did not allow of any operations being undertaken on an extensive scale. In 1911 as far as we knew the disease was confined to a few Masai villages in the Laikipia district. The Masai had considerable previous experience of the disease and in this case imposed quarantine restrictions on the infected herds. A Veterinary Assistant was in charge of this quarantined area for a time and carried out inoculations with field virus. The District Veterinary Officer, however, decided that the results were so uncertain that it was inadvisable to proceed with the inoculations until such time as a laboratory culture could be produced and made available for issue. Field virus was sent down to Kabete and successfully passed through calves, and some of the virus so obtained was used on a small scale. The Laikipia Masai were moved in 1912 into the main reserve and before moving the infected herds all visibly infected animals were destroyed. On arrival in the main reserve an area possessing natural boundaries was set aside for the infected herds and the Masai in the neighbourhood were asked to assist in maintaining the quarantine. Ten or eleven thousand head of suspect cattle were in that area in 1914. During the war the disease spread throughout the Masai Reserve and in 1919 it extended westwards into the eastern portions of the Nyanza Province and has since gradually spread throughout the whole of the Nyanza Province. In 1919 a Military Supply Column from the Sudan is believed to have introduced Pleuro-pneumonia into the northern portions of Uganda and Kenya. Several outbreaks occurred in the European areas and the method adopted in dealing with these was to slaughter all cattle in infected herds: the military took over the carcases at valuation, and the cost to Government of these operations was not very considerable. Later it was not possible to market the meat and for financial reasons the "stamping out" policy was discontinued. The present position is that we issue vaccine free to stockowners and when an outbreak occurs on a farm quarantine restrictions are imposed. The infected cattle are segregated and every effort is made to persuade the owner to slaughter them. In-contacts are vaccinated and quarantine is raised three months after the last sick animal was removed from the herd.

Dr. P. R. VIJOEN asked whether compulsory slaughter of infected cattle was enforced because in South Africa no real progress was made in stamping out the disease until this measure was adopted. If it is not done in this country the chances of eradicating the disease completely seem very remote.

Regarding the infected areas in Uganda it would appear from the information supplied to-day that the old method of using field virus could be considered satisfactory. But it is very gratifying to anybody working in the laboratory to find that the method of inoculation has been so perfected as to be brought into the laboratory. It is always more satisfactory if the inoculation material or virus could

be prepared in a scientific manner in the laboratory. Mr. Walker deserves the k he has done in this direction. The mortality oculation is stated to have been 20%. I don't the Union. There have been some heavy losses eal reactions our farmers were not very much re more inclined to purchase cattle possessing were certain that such animals were salted

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The Chairman asked if Mr. Walker could state the cost of preparing his vaccine?

Mr. J. Walker: It is difficult to arrive at any correct figure as to the actual cost of the preparation. In the cost, the overhead charges should be included, which are difficult to state for a particular vaccine. The actual cost of the vaccine is small. The cost of the Veterinary Research Officer, assistants and laboratory material required, and packing material, such as bottles, etc., works out at 30 cents (about 3½d.) per dose.

Dr. P. R. Viljoen: I would like to point out that at Onderstepoort we are often asked to submit statements on the cost of production of different vaccines and that it is an extremely difficult matter to arrive at a correct estimate. There are many overhead charges and it is only fair to include research work carried out in connection with the production of the vaccine. I am afraid we shall not get very far in our discussion on questions of this sort.

Mr. F. J. McCall: I have listened with great interest to the experiences of both Mr. Power in South Africa, and Mr. Kennedy in East Africa in connection with Pleuro-pneumonia. In as far as can be ascertained, Pleuro-pneumonia is confined to the Masai section of the Arusha district in the vicinity of Kilimanjaro on the Tanganyika—Kenya border.

The period of six weeks quarantine was to[illegible] increased to three months.

Mr. W. KENNEDY: Might I ask if you reino[illegible] or if only one inoculation was carried out.

Mr. W. M. POWER: Only one inoculation. [illegible] suffered from too severe reactions, but where the[illegible] were reinoculated. The majority of cattle did r[illegible]

THE CHAIRMAN referred to the disease in U[illegible] a few years ago, and since has become scattered[illegible] Over 300 centres of infection have been recorde[illegible] only about 40 remain to-day, the remainder ha[illegible] have been conducted on as intensive a scale as[illegible] pneumonia is one demanding mass effort over a[illegible] Unless the present supervision is continued the[illegible] firmly established will be almost impossible o[illegible] time appears hopeful.

The speaker referred to the use of field vi[illegible] difficulties was more widely employed than la[illegible] practice that the addition of 25% glycerine wa[illegible] 10 days prior to use. Five per cent carbolic a[illegible] could be employed up to a month after collect[illegible]

One officer had reported that following va[illegible] action of inoculation was to hasten the deaths[illegible]

Mr. H. H. BRASSEY EDWARDS: In a larg[illegible] vaccinated with 5 c.c. culture vaccine only o[illegible]

Mr. W. KENNEDY gave a brief history of[illegible] From native evidence Pleuro-pneumonia was[illegible] 35-40 years ago, but Rinderpest came along la[illegible] it out. In 1906 about six infected centres we[illegible] country and apparently they had no connec[illegible] that time did not allow of any operations bei[illegible] In 1911 as far as we knew the disease was co[illegible] Laikipia district. The Masai had considerab[illegible] and in this case imposed quarantine restri[illegible] Veterinary Assistant was in charge of this[illegible] carried out inoculations with field virus. Th[illegible] decided that the results were so uncertain t[illegible] the inoculations until such time as a labora[illegible] made available for issue. Field virus was[illegible] passed through calves, and some of the virus[illegible] The Laikipia Masai were moved in 1912 in[illegible] the infected herds all visibly infected anim[illegible] main reserve an area possessing natural bo[illegible] herds and the Masai in the neighbourhood[illegible] quarantine. Ten or eleven thousand head[illegible] 1914. During the war the disease spread[illegible] 1919 it extended westwards into the easte[illegible] has since gradually spread throughout the[illegible] 1919 a Military Supply Column from the[illegible] Pleuro-pneumonia into the northern port[illegible] outbreaks occurred in the European areas and the method adopted in dealing with these was to slaughter all cattle in infected herds: the military took over the carcasses at valuation, and the cost to Government of these operations was not very considerable. Later it was not possible to market the meat and for financial reasons the "stamping out" policy was discontinued. The present position is that we issue vaccine free to stockowners and when an outbreak occurs on a farm quarantine restrictions are imposed. The infected cattle are segregated and every effort is made to persuade the owner to slaughter them. In-contacts are vaccinated and quarantine is raised three months after the last sick animal was removed from the herd.

DR. P. R. VILJOEN asked whether compulsory slaughter of infected cattle was enforced because in South Africa no real progress was made in stamping out the disease until this measure was adopted. If it is not done in this country the chances of eradicating the disease completely seem very remote.

Regarding the infected areas in Uganda it would appear from the information supplied to-day that the old method of using field virus could be considered satisfactory. But it is very gratifying to anybody working in the laboratory to find that the method of inoculation has been so perfected as to be brought into the laboratory. It is always more satisfactory if the inoculation material or virus could

be prepared in a scientific manner in the laboratory. Mr. Walker deserves the thanks of this country for the work he has done in this direction. The mortality following on the old method of inoculation is stated to have been 20%. I don't think this has been experienced in the Union. There have been some heavy losses in isolated cases and as regards local reactions our farmers were not very much afraid of these. In fact, they were more inclined to purchase cattle possessing only a piece of tail, because they were certain that such animals were salted against lung-sickness.

Regarding the method introduced by Mr. Walker it is not clear why the second inoculation is necessary. It has not been explained what degree of immunity resulted from the first inoculation in the tail, and whether this was not sufficient to protect against the disease. I was extremely interested in the methods of diagnosis described by Mr. Walker. I would like to have full information on the technique of the conglutination test as employed by Mr. Walker, and perhaps he would be kind enough to demonstrate it to us at the laboratory. We have tried this test in the diagnosis of other diseases, but had no great success with it. Apparently Mr. Walker has had better results, so that from the laboratory point of view I would like to see his method in detail. Mr. Walker mentions that the anti-body unit in the blood of sick animals is a large one and that it commences to decrease as soon as recovery takes place. In other diseases some anti-bodies persist for a long time after recovery. It is important from the diagnosis point of view to know how long after recovery the anti-bodies can be demonstrated in the blood by his test.

Mr. H. E. Hornby: Re heavy mortality: I remember that Mr. Gray, who was then Chief Veterinary Officer, Union of South Africa, told me that in spite of inoculation with field virus the disease caused great mortality when first it appeared in Southern Rhodesia, while later such heavy losses were prevented by similar inoculations. This was also the case when the disease appeared in Barotseland in 1915.

Mr. W. Kennedy: The outbreaks I referred to where a heavy mortality occurred after inoculations were all on European farms and involved grade, as well as native cattle.

Mr. W. M. Power: Did you give facilities for farmers to send away infected animals?

Mr. W. Kennedy: A few cattle have been slaughtered on farms. Facilities have been given in some instances to move visibly infected animals under quarantine to the butcher.

Captain B. A. Jarvis exhibited photographs taken in the Sudan of cattle showing a horny excrescence on the point of the nose, which is thought to be the result of a subcutaneous inoculation of lung tissue by the natives against Pleuro-pneumonia.

Mr. W. Kennedy omitted to mention in reviewing the history of Pleuro-pneumonia in this territory that in June of last year an outbreak occurred in the Northern Frontier District. On enquiry across the Abyssinian Frontier it was ascertained that the disease had been prevalent there for six months. Before we could control the movements of cattle in the area involved the disease had spread down to a quarantine station about 160 miles from Nairobi. The whole Northern Frontier District is now under suspicion for this disease. That district is largely desert country with large herds of cattle which congregate in considerable numbers at wells and waterholes. Abyssinia possesses no veterinary organisation and this fact makes that territory a continual menace to Kenya.

The Chairman asked if Mr. Walker could state the cost of preparing his vaccine?

Mr. J. Walker: It is difficult to arrive at any correct figure as to the actual cost of the preparation. In the cost, the overhead charges should be included, which are difficult to state for a particular vaccine. The actual cost of the vaccine is small. The cost of the Veterinary Research Officer, assistants and laboratory material required, and packing material, such as bottles, etc., works out at 30 cents (about 3½d.) per dose.

Dr. P. R. Viljoen: I would like to point out that at Onderstepoort we are often asked to submit statements on the cost of production of different vaccines and that it is an extremely difficult matter to arrive at a correct estimate. There are many overhead charges and it is only fair to include research work carried out in connection with the production of the vaccine. I am afraid we shall not get very far in our discussion on questions of this sort.

Mr. F. J. McCall: I have listened with great interest to the experiences of both Mr. Power in South Africa, and Mr. Kennedy in East Africa in connection with Pleuro-pneumonia. In as far as can be ascertained, Pleuro-pneumonia is confined to the Masai section of the Arusha district in the vicinity of Kilimanjaro on the Tanganyika—Kenya border.

On assuming veterinary charge in Tanganyika in 1919, I visited Arusha, toured the country, confined the outbreaks and formulated the quarantine scheme which was subsequently approved by the Administration. The main factor in this scheme was the collection and segregation under close observation and control of all the infected kraals which at the time were scattered throughout the Arusha—Masai country. A quarantine area was then selected and in consultation with the Political Officer it was decided to postpone evacuation of the clean and collection of the infected herds until the advent of the rainy season. By July 1920, 47 bomas with an aggregate of 40,330 head had been located; with the exception of 510 head on two European farms, all the rest were moved into quarantine. During the first year subsequent to the initial rounding up a further 11 kraals (14,339) head were discovered and included in the segregation area.

In the second year one outbreak was detected and was included in the main area and this, the third year, a further infected kraal has been discovered.

The significant fact to be observed is that 54,154 head placed in the quarantine area have subsequently increased in spite of a severe drought to 76,233 head, a net increase of 22,079. This apparently satisfactory state of affairs is capable of two interpretations, viz.: that the search made, and being made, is not sufficiently thorough to detect the few obscure cases which are occurring; or, that the disease has died out. If it has died out good and well; if it has not— and I am scarcely so optimistic to think it has—then should it show any tendency to break out again we are reasonably sure to become aware of its presence in time to deal with it as heretofore. Hitherto only one case of recrudescence of the disease has been recorded amongst the newly-born calves in the recovered herds. This phenomenon is most important and lends colour to the belief that "old lungers" are not such an important factor in Pleuro-pneumonia in Tanganyika as was formerly believed.

Quarantine, as applied to the area under supervision for Pleuro-pneumonia in Masailand, apart from a certain amount of unavoidable restraint, in no way interferes with the internal economic progress of the people, but on the contrary, as already shown, seems to have made for prosperity in the particular circumstances under review.

In the pastoral districts of Kenya and in Karamoja Pleuro-pneumonia when uncontrolled manifested itself as a virulent disease capable of causing great loss.

When subjected to a measure of supervision, as in the Arusha quarantine area and in the Eastern province of Uganda, indications are not lacking that the disease may prove more amenable to control than could hitherto have been anticipated.

The total number of deaths from Pleuro-pneumonia during the year is 365, of which 136 have occurred in this year's new outbreak, 174 in infected herds introduced in 1921, and the remaining 55 in the small recrudesence referred to above.

Mr. W. M. Power: It is not clear whether Mr. McCall inoculated all those cattle.

Mr. F. J. McCall: No. They were simply collected and quarantined in order to prevent the spread of infection pending further investigations into inoculation methods.

Mr. W. Kennedy: Do your Masai agree to slaughter female stock?

Mr. F. J. McCall: Yes, they slaughter clinical cases, we encourage them to do so. We are unable to contemplate compulsory slaughter of incontacts, but at the end of four or five years if no further cases are detected we will assume that the controlled herds are clean.

Mr. H. H. Brassey-Edwards suggested the vaccination of calves as they come along each year. In herds thus inoculated each year it is reasonable to assume them clean after a period.

Mr. F. J. McCall: This aspect of the case has been considered, but to obtain a reliable vaccine is the chief difficulty.

The Chairman: Is it essential to get reaction in order to get immunity?

Mr. J. Walker: Yes. It is necessary to have a reaction to get immunity.

Mr. J. T. C. Bradshaw: Culture vaccine was used recently on 160 head of susceptible animals, half were inoculated in the tail, and half in the shoulder, with two different strains of vaccine. These animals were tested for their resistance a month afterwards by the inoculation of a second generation virus. Twelve beasts previously not vaccinated were similarly treated and served as controls, of these latter 90% died. The previously vaccinated animals showed no reaction exceeding three inches by three inches to the immunity test.

Mr. F. J. McCall: When a measure of veterinary control is applied, it seems that the results are very beneficial indeed and since the quarantine was put in force very little extension has occurred.

Mr. J. Walker, in reply to the discussion said, regarding the failure to produce reactions by inoculation, it is well known that a percentage of susceptible cattle may not react to an original, but may react to a subsequent inoculation. This cannot be explained as being due to a natural immunity, inasmuch as an animal which fails to react may react to a subsequent inoculation.

In regard to the failure to get reactions in vaccinated animals as stated by Mr. Hornby, this is difficult to explain. I don't think it is due to the vaccine having to be transported from the Kabete Laboratory to Mpapua Laboratory. Vaccine was transported to Laikipia and used three weeks after issue and it gave good results. I believe cattle were inoculated with the same vaccine as was sent to Mpapua.

Mr. J. T. C. Bradshaw: Cattle were not inoculated. We inoculated media here and produced a growth. Some of the same lot of vaccine sent to Mpapua was inoculated in media at Kabete when we received a cablegram advising arrival of the vaccine sent to Mpapua and a good growth developed in the normal tissue in the inoculated Kabete medium.

Mr. J. Walker: Inoculation alone is not sufficient for the eradication of the disease. All infected cattle must be detected. It is unsatisfactory to use a virus in which the viruleney is not fixed.

The losses in this Colony of about 20% with the field virus to which I refer did not always occur; when the same virus was used on other farms there was little or no mortality.

In this Colony when an outbreak has existed for some time it is difficult to get sufficient field virus to inoculate. The method of obtaining virus by passage, at the laboratory, is not satisfactory. A number of the animals inoculated "behind the shoulder" will always react, but we do not know what quantity of virus we are going to obtain, and if the demands are great you cannot guarantee any issues. With the pure culture vaccine you can guarantee an unlimited quantity within a certain time.

Dr. Viljoen says they used the conglutination method for the diagnosis of other diseases with not much success; but our results with the conglutination test in Bovine Pleuro-pneumonia are satisfactory.

With regard to the anti-body unit this varies in different sera, and we know that the anti-body is also present in animals that have had the disease for some time.

In animals which we have had under observation at the laboratory we have found the anti-body unit decreases. The degree of immunity depends, says Nocard, on the intensity of the reaction.

I do not know how long the immunity actually lasts after natural infection, but it is thought that an animal recovered from a natural infection has a longer immunity than an animal which has been artificially immunised (inoculated).

Well, Mr. Chairman and gentlemen, I will now conclude by saying that the position is quite clear. It is hopeless to try and eradicate the disease by inoculation.

South Africa happens to be one of those colonies where the disease has been stamped out by methods other than those adopted in other countries.

As long as you have an infected herd you will have a risk of infection, that is to say, you still have the disease amongst your cattle, on the other hand, in the reserves particularly, you have a number of recovered animals which are resistant the disease, but the disease is maintained by the young stock.

RESOLUTION.

Bovine Contagious Pleuro-pneumonia.

That this Conference considers that Bovine Contagious Pleuro-pneumonia can be controlled and eventually eradicated in the areas where it now exists, provided that the necessary facilities are made available.

But to accomplish this it is essential that veterinary measures be accorded the very fullest support and active co-operation from all Government officials.

(A) SPECIFIC ANIMAL DISEASES.

(2) Rinderpest.

Mr. H. E. Hornby (Veterinary Pathologist, Tanganyika Territory): It is a satisfactory subject which I am introducing to your notice, because although, as its name indicates, Rinderpest is one of the most important potential scourges of cattle yet it is one which we can combat successfully.

We all know the appalling mortality which attended the spread of the disease from the north to the south of this continent 30 years ago, and the consternation then experienced was still being reflected in the views expressed at the last Pan-African Veterinary Conference of 1913. By that year the disease had receded northwards until the Union of South Africa, Rhodesia and Nyasaland were free, but it still existed in most of the other countries. The fear of its return to the south was then very real. It is pleasant to be able to think to-day that this fear has been removed.

So thoroughly did Rinderpest do its evil work at the time of the great epizootic, that most of the survivors among susceptible species of animals were individuals of exceptional natural resistance to the disease; a property likely to be inherited by their offspring. Other survivors were those which had escaped infection. As might have been expected, when the disease reappeared in the southern parts of what was then German East Africa in 1916, the 95% cattle mortality of 20 years before was replaced by one of about 35% while game scarcely suffered at all.

An important thing about Rinderpest is the solidity of the immunity which one attack confers. Another important thing is the powerful influence which anti-rinderpest serum exercises on the course of the disease. Given the necessary technical staff and an adequate quantity of serum the suppression of any outbreak presents few difficulties, and need not be attended by much loss.

We have freed from Rinderpest all that part of Tanganyika Territory which lies south of the Central Railway, and we hope that our efforts to stamp out the disease in that country, from the south northwards, will be part of a great concerted movement which will result in the disease being swept back to those regions beyond this continent whence it came a generation ago.

In those countries where natives are suspicious of interference, where police cordons are unprocurable, and Administrative Officers not always sympathetic, a small technical staff may find it hard to fight a winning battle against Rinderpest. There is a possibility that game might frustrate our efforts, or that the carriage of infected meat or hides might lead to fresh outbreaks, but my belief is that the main factor in stamping out the disease is *control of cattle movements*, and that could we effect this we should soon see the last of Rinderpest. To this end the aid of Administrative Officers should be urgently entreated.

The availability of adequate quantities of anti-rinderpest serum is guaranteed by the half-dozen laboratories in Africa which are turning out this material. I have shown recently that a high grade serum can be produced when the method of hyperimmunisation consists solely in drenching immune animals with large quantities (4 c.c. per lb. body weight) of virulent blood. An isolated field worker could thus easily prepare his own anti-rinderpest defibrinated blood, but it is generally more practicable to obtain a supply of serum from a laboratory.

The manufacture of anti-rinderpest serum in a laboratory is a straightforward matter. Many problems there are in connection therewith which require research; but they are not very urgent, being concerned mostly with the commercial aspect of reducing the cost of production.

We have the necessary knowledge, we can manufacture the serum; if we lose the fight against Rinderpest it will be a fault not a misfortune.

Mr. E. Hutchins: Our first outbreak of Rinderpest in Uganda since the great epidemic of 1890, was reported in May, 1910, on the East African border and the disease spread very rapidly as far as the Nile; most of these outbreaks died out under quarantine during the ensuing eight months.

Other outbreaks occurred later in 1910 in the north-eastern districts, towards Abyssinia, whence the disease appears to have come, and from these outbreaks the epidemic became widespread in the eastern province in 1911. The measures taken prevented the epidemic crossing the Nile until late in 1913, when outbreaks occurred in the Mengo District; these had all been stamped out by quarantine and by inoculation early in 1915.

In June 1917, it again crossed the Nile when an outbreak occurred amongst the buffalo in the Sleeping Sickness areas in Bunyoro; from this original centre it spread westwards through the game in the uninhabited sleeping sickness areas to the shores of Lake Albert. It also was spread southwards through the game in tsetse fly areas and in an area from which the cattle had been removed and it was only nine months after its introduction that it reached the cattle.

In 1919, it had reached the Congo and Ruanda; but now our two provinces west of the Nile are clean. It may be re-introduced from Ruanda or from our eastern province where small outbreaks are constantly occurring and are being dealt with by quarantine.

As regards game, bush pig died in very large numbers and bush buck appeared to be the most susceptible amongst the antelope. Buffalo died in many places, but nothing to the extent they were reported to have done in the 1890 epidemic. The bush pigs in some places were almost exterminated.

Mr. W. M. Power: My experience is very old. We have had no Rinderpest in South Africa for 17 or 18 years; we had the big outbreak in 1896-1897, and then the disease was largely dealt with by the Bile method and eventually by serum, in those days defibrinated blood. We had no more Rinderpest till towards the end of the Boer War and then the northern part of Natal was infected. It was again dealt with by the Bile and serum methods. On the whole it did not take very long to clear these areas and from that time the country has been clear of the disease.

In the second outbreak there were many immune cattle which we used for the purpose of the serum, and proved quite satisfactory. We established serum camps and obtained many cattle that had recovered from the old outbreak and used these as serum cattle.

The Chairman: I would like to know whether it is possible for Rinderpest to appear in a mild form as to escape observation?

Mr. W. M. Power: It did not occur in a mild form in South Africa.

Mr. W. Kennedy: The position with regard to Rinderpest in Kenya Colony cannot be described as satisfactory. In native reserves it is extremely difficult to enforce quarantine, or to carry out any repressive measures. When rinderpest first appeared here in 1891 it killed off not only the cattle but most of the game and after some years it appeared to die out, but undoubtedly disease centres remained unnoticed in some of the native areas, and in 1906 it began to assume epizootic form again. In 1906, 1907 and 1908 it spread in the North Eastern portion of this territory and from 1911 onwards practically every native reserve has suffered heavy losses ranging from 10% to 90%. The losses depended to a very large extent on whether the cattle involved had been in contact with the disease previously or not. The position in most of our native reserves now is that only the young stock are susceptible. Whether the disease appears in such a mild form that it escapes attention for a time or not is difficult to determine. We have had outbreaks on European farms originating in game when the disease assumed a very mild form. The Masai who have had considerable experience recognise two forms of the disease. When it appears in a mild form in a district, the owners of the herds in the neighbourhood will gladly infect their own cattle with that mild strain to safeguard them against the virulent form. Some of our Veterinary Officers consider that the mild form results from passage through game. Game has played a considerable part in the spread of Rinderpest in this Colony.

Mr. Hornby raised rather an interesting point with regard to the possibility of stamping out the disease by stopping movement of cattle. If our native tribal organisations could so control cattle movements that an effective quarantine could be imposed on an infected area, I think that little necessity would arise for veterinary interference in the way of inoculations. The trouble is that the average native does not appreciate the value of quarantine measures and if the disease enters his herd he almost invariably disposes of diseased meat to his neighbours, in order to cut his losses. Tribal customs frequently involve an interchange of cattle. Movement of hides has also contributed towards the spread of the disease in a few instances. The majority of natives thoroughly sun-dry hides before they move them from their villages; but one or two outbreaks to my knowledge have resulted through the movement of green hides, from one district to another, for the purpose of making shields, as dry hides are of no use for that purpose. The principal objection of Administrative Officers to quarantine measures is that they interfere with the collection of taxes. Stock-owning tribes can, as a rule, only pay their taxes by disposing of their stock and if a native area is in quarantine, the natives cannot dispose of their stock and therefore cannot pay their taxes.

The Chairman: Might I put it to you whether in your opinion should efficient quarantine measures be practicable you consider it possible to control Rinderpest?

Mr. W. KENNEDY: Yes. If it were possible to stop the movement of cattle the disease could be controlled in this way.

THE CHAIRMAN: And would the Administration remain unsympathetic if by these measures any particular area could be cleared?

Mr. W. KENNEDY: I do not think they would if such quarantine were only imposed temporarily. Unfortunately, owing to lack of veterinary staff, many of these quarantines remain in force indefinitely and this is naturally objected to.

Mr. U. F. RICHARDSON: I think a quarantine in a native area is a very difficult thing owing chiefly to the carriage of meat. The only method to prevent the carriage of meat is to prevent death, or reduce death to a minimum. That is one of the main objects.

Mr. F. J. MCCALL: I have no desire to convey an impression that our position in Tanganyika with regard to Rinderpest is altogether bad, on the contrary decided progress has been made and control is more effective than formerly; much however remains to be done. As a means of accomplishing Rinderpest eradication I do not believe in the overnight creation of a large inexperienced departmental staff, but rather inclined to a policy of gradual but sustained expansion. The difficulties of training men new to the country and devoid of local knowledge is self-evident, it being well-known that the services of a Veterinary Officer during the first year subsequent to his arrival are of a relatively restricted value. In Tanganyika, as in Uganda we are attempting the creation of a subordinate Native African Veterinary Service and provision has been made for the recruitment of such a body. We aim at enlisting only the more intelligent types of natives of from 18 to 23 years of age. Ability to write is of the greatest advantage while a knowledge of cattle is indispensable, the procuring of suitable lads possessing the dual qualifications is not easy, nevertheless, slow but sure progress has been made.

With regard to the manner in which the disease is generally spread while game are an important factor in this respect, in the majority of cases Rinderpest is disseminated direct from cattle to cattle; itinerant cattle trading being particularly culpable.

We have a permit system in Tanganyika, but with our present staff and owing to the lack of adequate administrative control of cattle movement which pertains in many districts, the regulations are disregarded.

In areas where the Chiefs are influential men, and own large herds quarantine is more effective and the position is good. In sparsely populated areas where the natives only own a few cattle especially if tribal control is lax the position is bad; amongst nomadic people the same applies.

Measures suggested for improving the situation:—

1. Increase in European Staff of Veterinary Officers and Stock Inspectors.

2. Improvement of the system of intelligence and control by increasing and training native personnel as Quarantine Guards, Scouts and Sub-Stock Inspectors.

3. Veterinary educative propaganda not only amongst natives but amongst all Civil Servants.

Tabora and Mwanza with over 1,000,000 head have never been so free as at present, only three very localised outbreaks which are controlled having been reported. The trouble is, however, that we never know when the disease may burst out again, and we have not adequate facilities for its early detection. Typical of this is the recent outbreak which occurred, and which is now raging, in the Pleuro-pneumonia Quarantine Area. This area has been kept clean for three years, but owing to surreptitious movements on the part of certain natives who broke through the quarantine at Mbulu, the disease has been introduced. Eland have become affected and a high mortality has been experienced. It may be interesting to record that in addition to animals such as eland, wart-hog, buffalo, bush-buck which are usually incriminated, I observed an acute outbreak amongst giraffe on the Uasin Gishu Plateau in 1912.

Understaffed as we are at present I prefer to deal with Rinderpest by the "Quarantine and serum method" rather than by the "Active immunisation process." If we could devise a means of approximating field conditions to those of the laboratory the position might be reconsidered. I am inclined to the belief that Rinderpest virus is constant, and that the differences in the severity encountered in outbreaks is attributable to degree of resistance on the part of the animals attacked, rather than to variations in the actual virus.

Whilst dealing with the subject of Rinderpest it would seem desirable to refer to and introduce for discussion the two analogous conditions, Catarrhal Fever and Gastro-enteritis, *i.e.*, Coccidiosis. In the spring of 1910 the existence of Rinderpest as such was not recognised in Eastern Africa, our German colleagues in Tanganyika shared this belief and our opinion was strengthened by the failure of Theiler, Stordy, Liebenheldt and Brandt to transmit the disease by inoculation. This was all the more extraordinary as the disease presented the clinical appearance of Rinderpest in all its aspects. The facts, however, had to be faced, namely, that the disease then widespread throughout Kenya was not inoculable even when the blood of several sick animals was pooled and inoculated into what were believed to be susceptible cattle. That the animals used in the above experiment did prove to be susceptible when subsequently inoculated with known Rinderpest virus would appear to increase the mystery, and either prove that the original animals from which blood was procured for the first inoculation were not affected with Rinderpest, or that some inexplicable adventitious factor was at work.

Whenever it has been my lot to double-inoculate cattle which have already passed through an attack of Gastro-enteritis reactions have been few in number.

In Laikipia a month after my arrival in Kenya I saw cattle dying in thousands of what I would to-day unhesitatingly diagnose as Rinderpest. It is easy to be wise in the light of subsequent experience, but to my mind there is every reason to believe that Rinderpest had been in the country and also in Tanganyika for a considerable period prior to its diagnosis as such; how long I would not care to surmise. With regard to the failure to transmit the disease as experienced by Theiler and his colleagues as I have already remarked, it has been subsequently proved that the animals used were susceptible.

It would, therefore, appear that we were dealing with two conditions and that the study of the one masked the encroachment and spread of the other. These are problems which I feel sure the laboratories of our respective departments will endeavour to elucidate. Suffice to say that Catarrhal Fever and Coccidiosis or Gastro-enteritis are not recognised to-day as important factors, are not referred to in our Reports and apparently have given place to Rinderpest which in as far as Tanganyika is concerned is the immediate economic problem of the moment.

Mr. H. H. Brassey-Edwards: At the request of the Chairman said:—District inoculations for Rinderpest undertaken under my supervision in this Colony have been considerable and principally among native-owned stock. The objects of the inoculations were to establish belts of immune cattle between infective native reserves and assumed clean areas; and the eradication of disease in infected areas.

Before commencing inoculations a certain amount of propaganda work is necessary with the native to explain the necessity and reasons, etc. Great prejudice exists among the stock-owning tribes when modern methods of inoculations are introduced, as they cannot understand why an incontact, and not necessarily sick animal, must be given anti-rinderpest serum. It is necessary to obtain the consent of the natives before undertaking an extensive inoculation, as without their consent very few cattle would be forthcoming.

After the natives have been persuaded, a Veterinary Census and Survey is made of the Reserve. By these means a complete inspection is made of the stock and all infected centres noted. Suitable cattle crushes are built in convenient centres—each crush is judged capable of handling about 3,000 head of cattle. It is necessary to keep inoculating at weekly intervals when operating in thickly stocked areas and to have five veterinary units, in order to keep ahead of the possible spread of infection from reacting animals, and to give each unit ample time to complete its work satisfactorily. All the inoculations are controlled by Veterinary Officers.

The success of Rinderpest inoculations in the field depends on the usage of very fresh virulent blood and the administration of a correct dose of anti-rinderpest serum.

Susceptible animals are obtained, preferably immune to tick-borne diseases, for the supply of virulent blood, and careful temperature records are taken after the animal has been inoculated with virulent blood. As a rule, on the fifth day, the control exhibits a second elevation of temperature; the animal is bled, and the blood used *immediately afterwards* for inoculation purposes. At the same time of bleeding, a second animal is inoculated with the blood, to act as a control to the virulency of the blood of the first animal, and in the event of the animal reacting the blood would be used for the next weekly inoculation. This reinoculation of controls is continued until the complete inoculation is finished. The serum is inoculated at the same time as the blood and I advocate the use of a larger index (20 c.c. per 100 kilos) of serum in animals under a year old, and a smaller index (15 c.c. per 100 kilos) of serum in cattle over a year old. These doses refer to

native cattle. The increased dosage for cattle under a year old is on account of their greater susceptibility to the disease. On completion of a daily inoculation a certain number of animals of all types are selected from the inoculated cattle, and daily temperatures are recorded and symptoms observed from 10 to 14 days in order to produce proof, or otherwise, of the success of the inoculations. If only a small percentage of the controlled cattle produce symptoms or record temperatures, an immunity test of inoculation of virulent blood is carried out. If animals react they are branded immune, with the exception of animals under one year old.

I am quite prepared to say that the method of double inoculation to eradicate Rinderpest in the native reserves in this country is premature and that the confidence of the native should be gained by the inoculation of anti-rinderpest serum alone, with quarantine measures.

With reference to the susceptibility of animals, I am inclined to think that native animals are just as susceptible as grade animals. Native cattle, following inoculation, are known to me to have shown very strong reactions, despite the use of large doses of anti-rinderpest serum.

Mr. J. Walker: I take it the object of re-inoculating cattle, which have been double inoculated, is to ascertain whether the blood used for inoculation was sufficiently virulent. Instances have occurred where a heavy mortality has resulted with inoculation of 24 to 36 hours old blood and the prescribed dose of serum. Some of the cattle reacted to Rinderpest. A number did not react, but subsequently contracted Rinderpest from the reacting animals. Experiments were carried out at the laboratory with the result that the use of fresh blood was recommended in future Rinderpest double inoculations.

Captain R. H. Knowles: In the Sudan, Rinderpest is controlled by the serum alone method. It is not considered advisable under present conditions to practise the double inoculation. A year ago I was informed by Mr. Littlewood, the Director of the Egyptian Veterinary Service, that the serum alone method had been employed in Egypt for some years, but without success. An active campaign of double inoculation was then decided on, and it was attended with great success.

In Egypt they had an adequate veterinary staff, good communications, a comparatively small area, and a comparatively small cattle population, and so the double inoculation could be efficiently carried out. On the other hand in the Sudan the opposite conditions prevail, there is a small staff in proportion to the cattle population and the area of the country is very vast. Also it is thought inadvisable to set up new centres of infection and to raise herds of susceptible cattle. It is for these reasons that the double inoculation against Rinderpest in the Sudan is not considered advisable.

Dr. P. R. Viljoen: I think we have overlooked a most important point in the question of Rinderpest eradication and that is the source of infection.

Your Chief Veterinary Research Officer is of the firm opinion that game is a natural reservoir of the disease. If that is so every effort should be made to settle this very important point first. I cannot for a minute see the advisability of using serum alone for producing passive immunity when a permanent source of infection is present in the country. If, therefore, it is definitely proved that game is a reservoir the only thing to be done is to actively immunise every susceptible animal in the country: otherwise you will have a fresh wave of infection coming in repeatedly. I should very much like to hear our Chairman's experiences in this connection.

Mr. W. Kennedy: My experience of the "serum alone" method in infected herds was, that the period of the infectivity of the herd was prolonged to a much greater extent than if the disease had been allowed to run its course.

The Chairman: It must be clear to everyone that the same conditions exist with Rinderpest, as we have already seen exist with Pleuro-pneumonia, namely, that different circumstances require different treatment.

The staff available in Egypt for the half-million head of cattle, is far in excess of the staff available in this country.

Most of the territories in eastern Africa are large, and the density of the population to the square mile is very low. Difficulties in respect of feeding, watering, etc., render it almost impossible to concentrate the cattle in bunches, except in a few selected places.

Game cannot be incriminated as permanent reservoirs, but only as carriers. From the experiments originally done at Kabete, and also those conducted in more recent times, it seems to me that it is wise to consider game as of the same importance as cattle. Put them on equality as possible menaces. Provided you are in a position to locate any outbreak immediately it occurs you can sit upon it and stamp it out, in the same way as you would stamp out an outbreak originating from movement of cattle.

I consider it is possible to eradicate Rinderpest from a herd or farm, provided you have the facilities and you have the staff. The larger the number of eyes available the more rapidly you are in a position to survey the whole area and to complete the disposition of your plans.

If we did but know the source of the outbreak, by the cautious employment of an adequate personnel we could sit upon each of the threatened centres.

Mr. H. E. HORNBY: In my opinion game are not reservoirs of Rinderpest.

Dr. P. R. VILJOEN: I do not consider it correct to use the word reservoir.

THE CHAIRMAN: No, I agree it is not correct to use the word reservoir.

Mr. H. E. HORNBY: No doubt some of the game get Rinderpest in certain areas, and die or recover from the disease, but that game should be looked upon as reservoirs in the accepted sense of that word has not been suggested by any evidence which I have seen.

THE CHAIRMAN: Provided you can sit upon each centre of infection as it occurs, and create a clean zone, it finally becomes a buffer zone to other areas. The limitation of the disease is due to the size of the buffer zone, especially the large areas where there is no stock or water. If the spread is to be stopped the personnel must be available: it can then be forestalled or overtaken. Re giraffe. At the time I was in Northern Rhodesia I met an old bishop, and I well remember him describing how giraffe in Tanganyika were lying dead of Rinderpest along the sides of the roads.

As to the cost of Rinderpest serum. It was estimated that at Kabete in pre-war days serum could be produced at the rate of 1s. 4d. (Re. 1) per unit. It must be remembered, however, that the unit at that time was a smaller unit than is used at present. Not long ago at the request of the Uganda Government, I drew up an estimate for the cost of production of Rinderpest serum. Estimating the price of the cattle as then current, also providing for buildings and staff in that locality, serum could be produced at the rate of S. 1 per unit of 50 c.c.'s including packing. I allowed a sufficient margin for all difficulties and incidental expenses met with in all serum institutions.

With regard to the game question, I would refer to sheep and goats, which after all are closely related to the small buck, which we consider to be most susceptible game to Rinderpest. At Kabete we conducted experiments with these animals, and we kept up a strain for ten generations through them. The only demonstrations we had with these animals was when they were bled on the sixth day, the sheep were carriers of the virus. No test was made as to the length of time the virus lived in the sheep. Field experiments, however, indicate that they are not permanent carriers.

I feel very confident, that provided you can have sufficient personnel to survey your country, and to locate where disease exists or does not exist, according to circumstances encountered, that it will enable us to promise our respective Governments that Rinderpest can be eradicated. If this is done in each territory, we shall create that enormous buffer from which we can take steps for the eradication of the disease. There are natural barriers which will prevent it spreading, and by a system of veterinary posts, along the danger zones, the disease should be kept under control.

Mr. McCall has referred to the disease known as Gastro-enteritis in Kenya, and Malignant Catarrhal Fever in what was German East Africa. In the latter country it had existed for some years prior to 1907 at which time it first attracted attention in Kenya. In that year it appeared as an epizootic, with a mortality, especially among calves and old cows. The symptoms were those of Rinderpest, the course of the disease and the naked eye pathology were similar: but inoculation and contact experiments carried out by Theiler and Stordy were negative, as were those performed by Lichtenheldt in German East Africa. These experiments tended to eliminate the diagnosis of Rinderpest which would otherwise have been justified.

Soon after my arrival in August, 1909, I was able to observe the disease, but not to conduct any inoculation experiments. In every acute case studied at Meru and Kisumu, Coccidia in large numbers were found in the fæces. On the island of Ukerewe in German East Africa, Coccidia were again found, and inoculation experiments carried out with cattle from believed disease-free islands were negative. This was in November, 1909. In May, 1910, what was apparently the same disease appeared at Njoro, and further inoculations were carried out, this time with most striking and definitely positive results. This outbreak was true Rinderpest.

I was subsequently able to obtain the cattle used by Theiler and Stordy, and to demonstrate that they were susceptible to Rinderpest, although they had failed to react to the original experiments with "Gastro-enteritis."

At a later date it was shown that cattle immune to Rinderpest were susceptible to Coccidiosis

It appears, on the evidence, clear that two diseases, having similar symptoms, occurred in eastern Africa in 1908-1909-1910. What amount was due to "Gastro-enteritis" and what to true Rinderpest is indicated only by the failure of Rinderpest in later years, to cause serious losses in some herds which had previously been affected: in others, however, the first sickness gave no immunity to subsequent Rinderpest. The exact distribution of the two infections cannot be ascertained, but it would appear that the introduction of Rinderpest was masked in Kenya is it was in German East Africa by a disease of similar symptoms, which was not inoculable. The exact relationship and connection between the two remains unknown, but it is instructive to bear in mind the more recent work on Coccidia in connection with Rinderpest in another country.

Mr. J. Walker: I have listened with very great interest to the discussion on Rinderpest. When referring to game as being responsible for the spread of infection, what I intended to convey was not that a recovered animal is a reservoir, but that the disease may, as has been observed in uncontrolled outbreaks amongst cattle, spread slowly from the infected to susceptible animals and thus be maintained for some time. There seems to be a difference of opinion as to whether the disease should be dealt with by means of quarantine or whether the disease should be dealt with by producing an immunity, that is by methods of inoculation.

In 1896 when the wave of Rinderpest passed through Africa to the Colony of South Africa a considerable number of susceptible game existed between this Colony and South Africa, these were known to have become infected and, I believe, it is generally held that the disease was spread southwards by means of these susceptible game. I understand there now is less possibility of the disease spreading from this Colony to South Africa by susceptible game. It appears to be a general idea or opinion that Rinderpest can be controlled by controlling the movements of stock. I admit that in a country where game do not exist that this is possible. In this Colony we know that Rinderpest occurs in some game and it seems to me incorrect to consider that the disease can be controlled by controlling the movements of cattle, particularly since the movement of infected game cannot be prevented.

We know from our experience at the Kabete Laboratory that some game are very susceptible. We have experimented with wart hog and found them susceptible and capable of transmitting Rinderpest to cattle and *vice versa*. I admit that wart hogs do not travel any considerable distance. On the other hand there are game that move considerable distances and are capable of transmitting the disease over a considerable distance. I would like to know what the cost would be of dealing with the disease by the method of quarantine as compared with the methods of inoculation. By quarantine alone a considerable amount of expenditure would be incurred in maintaining the quarantine. On the other hand when the animals have been double inoculated we know that there is some finality. In a Colony like this where susceptible game exist it would be foolish, in my opinion, to raise susceptible cattle, which would—if a wave of Rinderpest swept as in former years through the Colony—result in heavy losses.

With regard to the methods of inoculation, as Mr. McCall has said, with serum alone there is no finality. When you inoculate serum alone a number of the susceptible cattle will contract Rinderpest: others will escape infection and remain susceptible.

When cattle react to double inoculation there is a lasting immunity. This is supported by observations made in South Africa when the first wave of Rinderpest passed through a number of infected animals recovered, and later when a second wave occurred these recovered animals were found to be still immune. In outbreaks which are dealt with by double inoculation the cattle which react remain immune. If quarantine regulations alone were instituted there would be a grave responsibility in raising susceptible cattle.

There are risks and difficulties in double inoculations which can be avoided. There is a risk of transmitting other diseases particularly, *e.g.*, Redwater and Gallsickness, but this could be avoided.

With regard to the preparation of Rinderpest serum; Mr. Hornby has stated the method of preparation required every consideration and experimentation. It seems to me that the methods in vogue at the present time for the production of Rinderpest serum are sufficient. The mortality should not be excessive if the inoculation is carried out with care.

It has been suggested that the disease may occur in a mild form and escape detection. This view I agree with.

With regard to resistance; it has been observed that some cattle are more resistant than others. Cattle born of immune parents possess some resistance, on the other hand grade cattle are less resistant.

Mr. H. E. Hornby: With regard to the cost of production: as was said yesterday, it is extremely difficult to arrive at a definite figure owing to overhead charges. When a farmer has an article to sell the price he gets is governed by the prevailing market prices, and these in turn, on an average must yield a margin of profit, but I do not think a mixed farmer can say what it costs him to grow any particular article. So it is with me: I know very well that if I were a commercial firm I should unhesitatingly accept a contract to put serum on the market at 1s. 6d. per dose, and still have a margin for reduction if necessary. We hope after another year's working to have definite figures, but they are not available at present.

Mr. J. Walker: It would seem to me that the method of arriving at this cost of production is not a commercial one. We have been told that it is a commercial idea. In estimating the cost of production of serum there is a large number of items to be taken into consideration, the cost of animals, feed, staff miscellaneous, etc., etc. We have also to take into consideration upkeep of plant, overhead charges, and the proportion of expenditure which is incurred in preparing Rinderpest serum, and other laboratory products. I admit that without spending a considerable time with figures it is impossible without a business method to arrive at the cost of preparation of serum.

Mr. F. J. McCall: With reference to Mr. Walker's views as to the advantages of double inoculation over the serum alone method, I think we all agree that an active permanent immunity is infinitely preferable to a transient passive one.

The point at issue, however, seems to me to be not so much one of what is desirable, but of what is possible.

Furthermore, I think sufficient stress has not been laid upon the success which has attended the method of seruming the clean cattle and mixing them with the diseased animals in an infected herd.

Experiments conducted in Kabete Laboratory, I think by Mr. Walker himself, and recorded in the Kabete publications, demonstrated that this procedure was most successful. The healthy serumed cattle, contract the disease on various specified days subsequent to their exposure and recovery occurs in almost all cases.

The results of these experiments largely influenced me in adopting that method in Tanganyika.

By its adoption, the reproach of killing the natives' cattle, a common reproach from people who reason "*Post hoc ergo propter hoc*" has been avoided.

With regard to the cost of Rinderpest serum production, the cost estimated at M'Papua is tentative, nevertheless, I think it is fairly correct.

Naturally a serum Institute, such as M'papua with few overhead charges, with a small European staff and with cheap cattle available, can produce serum more cheaply than an institute which deals with many financially unproductive problems and carries correspondingly heavy overhead charges.

Mr. J. Walker: We have been told that Rinderpest serum can be produced in Tanganyika Territory at the cost of 1s. 6d. per dose.

The dose would vary according to the susceptibility of the cattle.

I would like to know, how the cost of a dose can be arrived at, if no unit of dose is fixed upon.

Mr. W. Kennedy: At the Bulawayo Conference in 1913 I understand that one Delegate stated that he had noticed Rinderpest in sheep. In this connection I should be glad if Delegates would give their experience.

Mr. W. M. Power: I don't know of any information being available as to sheep and goats having contracted Rinderpest in the south.

(It was generally admitted by the Delegates that no Rinderpest in sheep and goats has been observed in the respective territories).

Mr. F. J. McCall: We have never had reason to believe that Rinderpest originated, or smouldered, amongst the game, but rather have thought that the disease usually died out completely, however, we have no absolute proof that such is the case.

Dr. P. R. Viljoen: It has been stated here that a mild form of the disease occurs in some cases. Apparently there is no definite proof forthcoming that this is so, and I consider it of the utmost importance that this point should be settled. If a mild strain occurs in cattle, then why should it not occur in game? In this way it may be possible to explain how game can be carriers of the infection, but they cannot be said to be "reservoirs" in the strict sense of the word, as was suggested by Mr. Walker and other speakers.

Mr. W. KENNEDY: Quoted instances in support of the views held by certain Veterinary Officers that Rinderpest became less virulent to cattle after passage through buffaloes and eland and thought that perhaps Mr. Hutchins might be able to give some information on this point.

Mr. E. HUTCHINS: No. We did not notice any difference in the virulence.

Mr. H. E. HORNBY: I think, Mr. Chairman, that question should be decided by yourself or Mr. Walker.

THE CHAIRMAN: My experience has been that the strain remains the same, but that the resistance of cattle varies.

RESOLUTION.

RINDERPEST.

That this Conference considers that Rinderpest can be controlled and eventually eradicated in the areas wherein it now exists provided that the necessary facilities are made available.

But to accomplish this it is essential that veterinary measures be accorded the very fullest support and active co-operation from all Government officials.

A. SPECIFIC ANIMAL DISEASES.

3. East Coast Fever.

Tick Destruction.

Tick-borne Diseases.

Mr. W. M. POWER (Senior Veterinary Officer, Natal). In attempting to deal with East Coast Fever I shall not refer to the disease in East African Territories, as I think it is preferable that the Delegates from those areas should explain the position in regard to the disease, and the steps, if any, that have been taken to deal with it.

I shall, however, refer to the Southern Protectorates, viz.: Swaziland, Basutoland, and Bechuanaland: as Dr. Viljoen and I were asked to represent those territories, but, unfortunately, time was so short before leaving that it was not possible to obtain information as regards the disease in those territories, so I have no detailed information on this subject.

So far as the Union is concerned East Coast Fever exists in the Transvaal, Natal and the Trans-Skei, and the Cape Province. I should mention that since Union the old Cape has been divided into two areas for veterinary purposes. The new area is known as the Trans-Skei and the other is referred to as the Cape.

The position of the disease in the Transvaal is that infection exists to some extent in six or seven districts. In some of those districts—I am referring to Magisterial Districts—only one or two farms are affected; in others five or six.

The most widespread infection existed in the Pretoria district where a very serious spread of the disease took place two or three years ago. Notwithstanding the spread of disease there, and the fact that the district was largely unprovided with dipping tanks at the time, much progress has been made towards eradicating and controlling the disease during the past two years.

On the infected farms, of which there were about 90, there are tanks and on a very large number of farms surrounding compulsory dipping is in force.

About 400 tanks have been erected in that district since the disease appeared there. Out of those 90 farms, I think I am correct in stating, that only two of them have had cases of East Coast Fever in the last 12 months, and only one or two deaths have taken place. In the Transvaal compulsory dipping is not in force all over the Province.

I think you will gather that the disease only exists in that Province to a limited extent, and at present the position looks very hopeful indeed when it is considered that there were so many infected areas.

Compulsory dipping is carried out all over Natal, as the disease is more widespread in that Province than it has been at any time in the Transvaal, and also the climatic and geographical conditions differ considerably from those in the Transvaal. In the latter there are very considerable stretches of high, open veld, and in Natal high veld areas are limited.

In the Cape there is only one centre of infection, *i.e.*, on the borders of the Trans-Skei, where a rather mysterious case of East Coast Fever was diagnosed some nine or 10 months ago; I think that no further cases have occurred. That is the only centre of disease in the Cape Province.

In the Trans-Skei most of the infection is in the native territory, but there are also a number of private farms infected in one district adjoining Natal.

In Bechuanaland there is no East Coast Fever, neither is there in Basutoland, but the disease exists in Swaziland.

I have no information as to the actual position in Swaziland at the present time, but I think the areas are fairly limited.

The policy for dealing with this disease in the Union at present is dipping, tick eradication, fencing and quarantining. Those are the main precautions taken.

Dipping in a five-day dip, and in a three-day dip, respectively, was carried out for some time and was, I think, given a fairly good trial in practice, but the latter was eventually discontinued in Natal and I believe in other areas later.

The aim is to carry out dipping and hand-dressing under official supervision on every infected area, in order to see that the dipping material in the tank is maintained at the proper strength, and that all the cattle are dipped, and hand dressed. We discontinued the three-day dip at a time when we had a much smaller staff than at present; it was impossible to arrange for regular supervision, with the result that in many cases dips were not kept up to the standard strength required and heavy mortality took place.

Five-day dipping can be supervised by the staff now employed, but a much larger staff would be necessary to enforce dipping at the shorter interval mentioned.

Another objection to three-day dipping is that cattle have often to be driven over long distances to the tank. If this is to be done every 72 hours, as that is what a three-day dip means, the cattle would get very little rest, and especially in winter time when they are in poor condition and grazing scarce.

We have at the present time sufficient staff to enable us to provide for supervision of all infected areas on every dipping day, and only in certain cases have any exceptions been made; perhaps, where only one death has occurred on a farm and where a spread of disease is not expected. In such cases the periods of supervision have been extended.

About 450 tanks have been erected by Government in native reserves. All work in connection with dipping in the native reserves is carried out under official supervision, *i.e.*, the Government provide the dipping material, maintains the strength of the dip, and supervises the actual dipping of the cattle. The natives have to bring their cattle to the tanks on the day set apart for dipping.

Regulations are in force, which prescribe the intervals at which cattle shall be dipped and, authority also exists for fixing the hour.

It has taken a long time to reach this stage, *i.e.*, in regard to the number of dipping tanks and better supervision. The aim is the entire eradication of the disease, and, therefore, every effort is being made towards that end. The losses are not heavy where early diagnosis is made, and where efficient tick eradication measures have been carried out. Perhaps the greatest difficulty in regard to the eradication of East Coast Fever is in the diagnosis of the disease, especially now that dipping is so generally carried out throughout the country. I am now referring more particularly to Natal. All stockowners are fully advised as regards reporting deaths or illness and to sending smears. The European farmers comply with our request in this direction on the whole fairly well.

I have, however, known farms where the history of the outbreak indicated that they had been infected for long periods before the disease was diagnosed. If we could ensure accurate diagnosis in all cases and could get information of the first or second death, the entire eradication of East Coast Fever would be much nearer than it is.

The two main factors that mean success are effective tick eradication measures and early diagnosis. Tick eradication measures are very well carried out in infected areas. If they could be extended to the clean areas threatened with the disease it would be of the greatest assistance. There are large areas that never have been infected. I do not suggest close supervision in those.

When East Coast Fever first entered the country there was a heavy mortality, but in spite of East Coast Fever and other diseases, cattle have increased, in fact, there are too many now. Farmers have been importing good cattle from England and other countries with confidence for the last ten years or more, and if you attend the principal Natal Shows you will see as good cattle there as in any part of South Africa. Notwithstanding East Coast Fever the whole country is not in quarantine, but all movements throughout the provinces are under permit.

With the present staff we are hopeful that an improvement can be brought about, and we are making a very big effort in that direction.

Very satisfactory progress has been made in the Transvaal where an adequate staff was available and certainly the result obtained justified that very fully. I believe that with adequate supervision this disease can be eradicated from the Union. Many practical difficulties are met with, it is much more difficult to eradicate East Coast Fever from the low country than from the higher and open land; most of the staff is employed in the former. It is also the case, that if one of these farms where ticks are numerous becomes infected and a number of cattle die from East Coast Fever before short-interval dipping has been adopted, it is difficult to eradicate the disease from those farms without heavy loss, even with the most efficient dipping and hand dressing.

There is a Fencing Law and fencing is a very great aid to controlling East Coast Fever.

The infection may be carried by infected material such as hay, etc. I think cases of the disease also occur through accidental carrying of ticks in the clothes of human beings, etc.

I know of farms where isolated cases of East Coast Fever have occurred, and where cattle movement as a source of infection can be eliminated.

It has been the practice for all smears to be sent to Pietermaritzburg. Now, in Natal District Veterinary Officers do smear examination, and this is regarded as part of their duty. It often happens that these officers have advantages over Research Officers in the laboratory as when smears are sent in by a farmer direct to a Veterinary Officer on the spot, he can ask for and obtain further smears, when necessary, without delay.

TICK DESTRUCTION.

We, in Natal, are very much in favour of tick destruction; the greater part of Natal being a tick infested country. There is no doubt that successful stock farming could not be carried out in the days before dipping. I am quite sure, without dipping, we should not be complaining of the overstocked condition of the country. I think that every farmer in Natal realises this fact. Tick eradication is necessary in any tick infested country, but a general order cannot be issued before steps have been taken to provide dipping facilities.

In the majority of cases no compulsion was necessary in order to get tanks erected; there are now 5,000 tanks owned by private individuals, excluding about 450 erected by the Government in native reserves.

In a tick-infested country stockowners are well advised to face the question of tick eradication. We see the United States of America spending large sums of money on the work.

There are other diseases which render measures of tick eradication necessary. While cattle only are being dipped it is impossible to think that all ticks can be eradicated, as there are other animals, horses, sheep, etc., game also to be considered, but notwithstanding that, practical experience has shown by systematic dipping, etc., cattle can be kept practically free from ticks. With regard to other tick-borne diseases, there are certain serious diseases such as Heartwater which affect cattle, sheep and goats, that is carried by the Bont tick; the most difficult tick to eradicate. Other tick-borne diseases are: Piroplasmosis of cattle, Biliary Fever of horses and dogs, Heartwater, Anaplasmosis, so that apart from East Coast Fever, we are satisfied that it is necessary to continue dipping in Natal, and even apart from disease—even if this could be eliminated—ticks would be as numerous as ever in a very short time unless dipping was continued.

THE CHAIRMAN: What is the cost of a tank.

Mr. W. M. POWER: About £150, *i.e.*, if not too far from a railway.

THE CHAIRMAN: How many cattle are there approximately?

Mr. W. M. POWER: Approximately 1,500,000.

Dr. J. B. BOTELHO: Since 1917 this disease does not exist in Portuguese East Africa. The last infected area was Salamanga in the circumscription of Maputo. In July, 1917, all cattle were removed by river to the abattoir of Lourenco Marques by the Government, thus extinguishing the outbreak rapidly. Eighteen months having passed after the removal of the last oxen; a fresh stock was introduced there and so far no new case has been reported.

Tick-borne diseases—Redwater, Anaplasmosis, as well as infection with Theileria mutans are rare in local cattle, but the imported ones are frequently attacked, many of them dying of Redwater if they are not injected with Trypanblue in time. Many animals imported and immunised against Redwater and Anaplasmosis with the vaccine supplied by Onderstepoort Laboratory, have been killed in the district of Lourenco Marques by local Redwater or Anaplasmosis. This proves, in my opinion, that the virulence of these two diseases is more severe here than in Transvaal. The Nuttallia equi is very rare. The Piroplasma canis is rare amongst local dogs, and the treatment of trypanblue injection has proved satisfactory.

Heartwater exists in the southern districts, taking some victims annually.

Tick destruction—The building of tanks in Portuguese East Africa was found to be very costly, each dipping tank amounting to £500. There are, at present, 23 public dipping tanks in the southern districts, and there dipping was made compulsory to deal with Heartwater. Dipping is free to native-owned stock. Public dipping tanks, in my opinion, may be the means of transmitting diseases such as Anthrax, etc.

Mr. W. M. Power: The territory of Portuguese East Africa is the only one where East Coast Fever has been eradicated, I don't think there is any other country where it has been entirely stamped out.

Another point, is that in the early days in the Trans-Skei another system of dealing with the disease was adopted, and this was by inoculation. In those days there were no dipping tanks. It was essential that the only means of transport, viz.: oxen, should be kept on the roads.

The inoculation was devised by Sir A. Theiler and was carried out by Veterinary Officers on a very large scale. The result was that about 60% of the cattle were saved by this method, when at that time 95% would have been swept away without inoculation or dipping. It was not an ideal system of dealing with the disease, the inoculation perpetuated it, but it served the purpose at the time. As dipping came into force, we realised there was a chance of eradicating the disease by dipping. Where territories are situated in such a position, that nothing else can be done to combat this disease, it might be worth while considering some means of inoculation.

Mr. H. E. Hornby: Did native owners object to the inoculations?

Mr. W. M. Power: No serious objection was met with so far as I am aware; but it was not compulsory.

After going through this inoculation, the cattle were placed in grossly infected veld, and if they stood that, they were allowed to proceed and work on the roads.

Mr. W. Kennedy: So far as East Africa is concerned, the position here is very different from that in South Africa. I think East Coast Fever has existed in this country for centuries. The disease first came under notice in Nairobi in 1905 and it was thought then to have been imported from German East Africa in a herd of trade cattle. Strict quarantine measures were adopted, but after two years it was discovered that the disease was widespread in various parts of the country. The present position is that roughly half the country is clean, and half infected. Of the infected areas, some are classed as enzootic areas, inasmuch as practically every adult bovine in those areas is immune to the disease. In the enzootic areas the disease is generally kept alive through infection of the calves and a large percentage of them, estimated at from 20% to 80% succumb. In 1912 the Veterinary Department began to consider the advisability of introducing dipping, and the Chief Veterinary Officer, after attending the Buluwayo Conference in 1913, toured through South Africa to collect information. He put up recommendations on his return, to Government, which were generally approved. A certain amount of money was allocated for the purpose of building tanks, and in 1914 a commencement was made. At the same time a number of farmers were persuaded to erect tanks. Government tanks have been erected along the main roads and in townships. Forty-two Government tanks and over 250 private tanks have now been constructed in the Colony. The late war greatly interfered with the prosecution of the dipping scheme. After the war a fresh start was made to get the scheme completed, but it has again been held up indefinitely owing to financial stringency.

In 1920 a Cattle Cleansing Ordinance based on the Ordinance now in force in Rhodesia was passed by Government, but a clause was inserted to the effect that the provisions of the Ordinance should not be enforced in any area until the Government is in a position to advance money to small farmers to build dipping tanks; this has resulted in the suspension of the Ordinance.

In regard to fencing: I would state that few farms are fenced in this Colony.

In regard to the intervals between dipping in South Africa: I should like to know if Mr. Power thinks five-day dipping absolutely effective in controlling East Coast Fever, or if three-day dipping is more effective provided the dipping fluid is kept up to standard strength.

I should also be glad if Mr. Power would be good enough to state what material he recommends for hand-dressing, and if, in the case of an outbreak, it is customary to clip the brush of the tail; also, in regard to the checking of the strength of the dipping fluid, is this done at a Government Laboratory or do the Stock Inspectors check it by means of an isometer or similar apparatus?

We have a permit system in operation in this Colony, but it has not been brought in force simply on account of East Coast Fever. I understand in Natal it was introduced simply to control East Coast Fever.

Further, I believe, according to the Natal Act, anyone found with tick-infested cattle on a public road is prosecuted. I should be glad to know what the term "tick-infested" means, that is, what number of ticks must be present on an animal to justify prosecution.

In this Colony we have large numbers of natives resident with their cattle on European farms and a continual interchange of cattle goes on between these squatters' herds and the native reserves. This is one of the biggest difficulties we have to face in our endeavours to control the spread of East Coast Fever.

I should also like to know what assistance is given to farmers to build dipping tanks in Natal. What amount is advanced, and what interest is charged? Mr. Power said the cost of a tank in Natal is about £150: the cost of erection here is £400 to £500. Further, we only recommend concrete or masonry tanks. I do not know whether any of the Delegates have any experience of timber tanks. About a dozen farmers in this country have put up timber tanks. These are in areas far removed from the Railway and where timber is plentiful.

With regard to tick eradication: our biggest trouble is the presence of large herds of game in certain areas. In some of the native reserves, of course, tick eradication is possible owing to the absence of game in any large numbers, but in such areas as the Masai Reserve and the Northern Frontier District, the difficulties to be overcome in tick eradication would be enormous.

Several outbreaks of Heartwater have occurred in this Colony, but the mortality has not been great. An attempt to control the disease was made at one time by quarantine and dipping, and it was thought that 14-day interval dipping would give the best results. This was reduced to seven-day intervals afterwards, and, on one farm the sheep were dipped at 10-day intervals in a seven-day strength dip without any ill-effects being noticed. We have now given up the idea of trying to control Heartwater by legislation as the mortality seems to be negligible, and the disease appears to be widespread.

Redwater and Anaplasmosis have assumed importance in this country mainly in imported cattle and in connection with Rinderpest inoculations in herds where dipping is regularly practised.

I should be glad if Dr. Botelho would give information as to the number of cattle at present in Portuguese East Africa.

Dr. J. B. Botelho: 300,000.

Mr. W. M. Power: Re strength of dip. I do not say that five-day dipping gives any better results than three-day dipping, but we have to work the matter out on general lines. If we had sufficient staff available, and could enforce three-day dipping and hand-dressing, it is possible that we would get slightly better results, but we have not got the staff to carry out three-day dipping. At one time we carried out three-day as well as five-day dipping, and we thought we were getting good results with five-day dipping, together with hand-dressing. We had no prospect of being able to provide supervision for three-day dipping.

Re hand-dressing: Various materials have been used, but the one preferred most is tobacco extract and oil, one to six, and the parts which are dressed are the ears and under the tail; we also clip the brushes of the tails. Hand-dressing is compulsory, as also is the clipping of tails.

As regards the test of dip by Stock Inspectors. Every inspector is provided with an isometer which he carries on the saddle. The dip has to be tested, after stirring, before the cattle are passed through.

We do not rely on this test completely. Sometimes trouble arises as to the strength of the dip, and then we avail ourselves of the Government Chemist for testing. Every official, however, is provided with an isometer.

The permit system was instituted because of East Coast Fever in Natal. The regulations provide that it is an offence to move tick-infested cattle on the roads. It is also an offence where the cattle are found on private farms. We are required, however, under regulations, in the case of the latter, to serve a cleansing order and if this is not complied with we can prosecute the owner. However, we generally find that the cleansing order is complied with. This regulation provides a loophole through which people can evade the regulations, but we hope that we shall be able to get it removed altogether.

We have the same questions about cattle moving between private farms and reserves. We do not usually issue permits for movements of cattle between farms and reserves, without the sanction of the farmer concerned, and then only if the area from which the cattle come is clean.

Re loan for tanks: The maximum is £200, and that is repayable by easy instalments.

Mr. J. A. Griffiths: I should like to know if Mr. Power has come across any cases of arsenical poisoning.

Mr. W. M. Power: Yes, not only from dipping, but also from malicious administration. The farmers, owing to accidental and also to malicious poisoning, requested that arsenite of soda be coloured, etc. There are liquid dips now on the market and the use of these is being encouraged, as they are safer and equally effective. I am personally very much in favour of having only liquid dip preparations used. I understand that a more reliable strength of arsenite of soda can be obtained in solution.

Mr. H. E. Hornby: From what Mr. Power and others have said, it appears, that all here are agreed that short interval dipping properly controlled is effective, in dealing with East Coast Fever and other tick-borne diseases. Therefore, in those countries where dipping tanks are available the problem of East Coast Fever is comparatively a simple one, and need not occupy our time further. I think we ought to discuss how to deal with East Coast Fever in those countries where dipping tanks are not available, and where the disease exists in a more or less enzootic form.

It is regrettable that we should have still to admit that there is no method of treating diseased animals.

To the extensive list of drugs which have been tried and found useless, I may add now tartar emetic, picric acid and brilliant green; all of which I tried and found valueless. We are left to-day without any remedy at all for the disease once symptoms are manifested.

To pass to the disease as it exists in the enzootic form: In Tanganyika large areas exist where apparently only immune cattle can survive. Other areas exist where the cattle are all or nearly all susceptible; and then there are areas where intermediate conditions prevail. The mortality in such a country is very great, and presents a problem worthy of our most serious attention.

Major Paul Tissie: According to Koch, cattle imported from Northern Madagascar to East Africa resisted East Coast Fever, while those that were derived from the southern parts of Madagascar, succumbed to the disease. Koch presumed that the northern Madagascar beasts are immune to the disease and that East Coast Fever must be present in those parts. I have been working in the provinces of North Diego, Majunke, etc., for at least six years and during that period I have never discovered any East Coast Fever.

Mr. W. M. Power: Mr. Hornby's suggestion is merely that the subject of East Coast Fever should be divided for consideration into two areas. One comprising the Union of South Africa, Rhodesia and Swaziland where a campaign is being carried out for the eradication of the disease, and the other, the East African Territories where the disease is regarded as enzootic. I think it is a good suggestion as I do not see how the position of the two areas can be dealt with together. The position in South Africa is different to what it is in the enzootic areas and I agree with Mr. Hornby's suggestion.

Mr. F. J. McCall: As Mr. Hornby has remarked, we find in Tanganyika that to attempt to erect dips throughout the country is economically impossible. A simple calculation of the number of cattle in the territory and the number of cattle which one tank can cope with, clearly demonstrates the truth of such a statement. Realising this, the Germans determined that whilst unable to eliminate East Coast Fever, they might minimise its incidence through the reduction of ticks by other means. To this end they instituted a law aiming at de-ticking native cattle by hand-picking. It may seem on the face of it rather a superhuman task, and in certain areas like the Masai country, where the people own large herds, it obviously cannot be done so thoroughly as in other areas where each native only owns twenty or thirty head of cattle; much, however can be achieved, especially if attention

is concentrated on the destruction of engorged female ticks. A study of intensity of cattle population, of tick incidence, of the relative frequency of swollen lymphatic glands in calves, and of the prevalence of East Coast Fever in any given district is not without interest. I have tentatively come to the conclusion that on open short grass veldt, on granitic soils in the absence of bush, even under heavy stocking and close grazing, tick incidence is comparatively low, swollen glands are not common and East Coast Fever is not prevalent. On the other hand, in districts where the soil is a stiff clay, where the rainfall is heavy, the grass long and the bush thick, ticks are numerous even although cattle are comparatively few and game is scarce. In such areas East Coast Fever is often enzootic, and the majority of calves manifest swollen lymphatic glands. A noteworthy feature in connection with East Coast Fever in enzootic areas is the difficulty experienced in diagnosing the condition amongst calves.

The German veterinarians in Tanganyika worked on this problem, but nothing definite could be ascertained. In the cattle areas of Tabora, Shinyanga and Mwanza, gland smears from 800 calves and yearlings manifesting this condition and showing temperatures of 103° or over in the morning, were examined this year. In only very few cases were Koch's blue bodies demonstrated; less than 1%. The position in Tanganyika to-day is that where the natives are nomadic and roam widely, East Coast Fever is not a serious problem, except in times of excessive drought, when the natives are compelled to concentrate their cattle on the few permanent waterholes remaining to them. In such circumstances, should East Coast Fever appear, it causes a mortality of up to 80% of cattle. In many settled villages in areas, where the natives are permanently resident and do not move their villages according to the seasons of the year, enzooticity is more intense especially on stiff clay soils. Between these two conditions every degree of enzooticity is encountered. We have clean areas with small nests of infection; we have large infected areas with small, clean islands. Turning to the attitude adopted by the natives themselves: they are fully alive to the good that can be done by de-ticking. Our endeavour is to induce them to adopt this practice, and teach other tribes that do not do so already. In the Tabora, Shinyanga and Mwanza districts of Tanganyika Territory, in as far as I can ascertain locally and from opinions expressed by the German veterinarians, the mortality is possibly 6%. On the Lake shores in the highly enzootic areas it is estimated as high as 40% or 50%. We know that on European settled farms, East Coast Fever often causes a death rate amongst calves of from 80% to 90%. Why this discrepancy should exist in the death rate amongst those various sections of the community is difficult to explain and it is evident, that many problems still in connection with the disease await elucidation.

Dips are already erected at Dar-es-Salaam, Dodoma, Tabora, Kondoa Irangi, Mpapua and Tabugwe. In Dar-es-Salaam dipping is compulsory, and judging from the results obtained, would appear to be justified.

Mr. E. Hutchins: I think in an enzootic area, it is rather difficult to ascertain what percentage of deaths amongst calves is really due to East Coast Fever, because the deaths reported include deaths from other causes. We have not worked out the percentage of the death rate due to uncomplicated East Coast Fever, and if we could ascertain that correctly, we would be in a much better position to judge what the real seriousness of the disease is amongst calves in enzootic areas.

Another point on which we have not got definite information, is the northern limit of East Coast Fever in Eastern Africa. I do not know if it has been found in the Southern Sudan. We think that the north-eastern part of Uganda is a clean area, but along the Nile the disease is enzootic right up to the Sudan border.

Captain R. H. Knowles, R.A.V.C.: Under the subject of East Coast Fever I would like to introduce into the discussion the disease known as Egyptian Fever, observations on which were reported by Mr. Eugene Mason of Cairo last year in the *Journal of Comparative Pathology*. Personally, I have not had an opportunity of observing either East Coast Fever or Egyptian Fever, and so my knowledge of these diseases is theoretical. Both diseases are, however, very important and interesting to us in the Sudan on account of the possibility of East Coast Fever spreading northwards from Uganda, where the disease is enzootic and the fact that Egyptian Fever has been reported to occur in Sudanese cattle exported to Egypt.

It is some years ago since East Coast Fever was reported to have occurred in Sudanese cattle exported to Egypt, but it has never been detected in the Sudan; and one has thought of the possibility of these cases diagnosed as East Coast Fever being cases of Egyptian Fever.

These two diseases show many similarities in their symptoms, lesions and histology.

Egyptian Fever is not a serious disease when compared with East Coast Fever.

Theileria annulatum is described as the cause of Egyptian Fever and morphologically it is very similar to the *Theileria parvum*; also there is present in the enlarged lymphatic glands, and in the hæmorrhagic infarcts in the liver, kidneys, and spleen in cases of Egyptian Fever, plasmospheres indistinguishable from Koch's bodies, seen in similar positions in cases of East Coast Fever.

Ulcers in the abomasum and intestines also occur in Egyptian Fever, also hæmorrhagic infarcts in the spleen, liver and kidneys.

The evidence available suggests that the disease cannot be set up in a susceptible animal by inoculation of blood from a case of the disease.

Egyptian Fever, however, differs from East Coast Fever in that it shows chronic and acute forms, and also shows a recrudescence of the fever after apparent recovery, with the presence of the parasites in the blood.

It will thus be seen that the two diseases have many points in common and I suggest to those working on East Coast Fever, that a comparative study of the two diseases might be made, in the hope that some light may be thrown on the question of immunisation against such a formidable disease as East Coast Fever.

THE CHAIRMAN: I think we are agreed that Captain Knowles has put his finger on two points in connection with enzootic East Coast Fever and its relation to Egyptian Fever. I discussed it with Professor Bitter, but from then until now no experiments so far as I am aware have been carried out with East Coast Fever infection upon cattle which are known to have recovered from Egyptian Fever. That would settle the point as to whether the two conditions are identical. In the early days it became necessary to establish the identity of our East Coast Fever with South Africa. Cattle immune to East African East Coast Fever were immune to the strain originating from Onderstepoort. Subsequently strains were taken from calves of this country and carried to Pretoria, where they successfully developed East Coast Fever, and animals immune to the disease of South Africa were also immune to that of East Africa. When one looks at the distribution of East Coast Fever in this country and Uganda, one is at once struck with the fact, that where there is the most infection, there is found the most cattle in density, per square mile. The Lake area is highly enzootic, and it is from that area that the great majority of the transport cattle came, and these animals are considered almost without exception to be immune. That statement is made after passing a very great number of such animals through an area on which infection was maintained heavily. The test being at least a six weeks residence on that area and a daily temperature and constant exposure of animals believed to be susceptible. I think out of something like 5,000 or 6,000 head only three so-called breakdowns are known to have occurred, and in two of these three cases the animals died about three weeks after liberation. They conceivably had merely escaped infected ticks until their last day. It naturally occurs then to one's mind, if there are so many cattle in this enzootic area, it is possible the strain there is of a milder character than in South Africa. The immunity experiments gave no indication of such a thing. The second point is—is the condition more mild when infection is conveyed to young calves? We attempted to put that to the test and infected ticks were put on calves from the day of birth and up to about a month old. These experiments shed no light on the subject. The results were inconclusive. Some calves succumbed, and others recovered: but the percentage of the recoveries shewed no indication on that question whether it was merely a question of age. The attempt was then made to maintain a mild strain by passage through calves and we reached the sixth generation, but could not get any indication or any answer to the question, "was the strain a milder one to that of South Africa." I may say that the South African strain was also run as an experiment, and the result of the two strains side by side was practically identical. The natives of these enzootic areas maintained, that although many died yet they effected a considerable number of cures by burning the swellings of the superficial glands. Some European farmers also maintain that the treatment is beneficial. The conclusion to, which we must come in our present imperfect state of knowledge, is that it is the same East Coast Fever, modified in some way unknown to us, either by inherited immunity of the cattle, or by constant passage, until it presents a different clinical and pathological picture. Calves born of immune parents got by immune bulls are found to be as equally susceptible as those born of others. I believe this is one of the greatest problems of the whole of Africa and one which should be investigated from first to last.

We know that by tick destruction we can control this infection, but the enormous areas covered by ticks, and the very great number of cattle occupying these areas, makes the problem a very big one, for the construction of a sufficient number of cattle dipping tanks for these cattle is certainly for many years to come a financial impossibility. Mr. Power's figures for the Union work out at one tank to 200 head of cattle. Even at his figures of £150, this means an expenditure of £625,000 on the construction of tanks in Natal alone. In this country the cost of tanks is higher. It was put by one speaker at £400. Further, although to the European with a few head of cattle, the annual maintenance of a dipping tank may not appear very great yet, if one accepts the figure of S. 2 per head per annum, 1,000,000 head of cattle cost £100,000 a year, and that is only the cost of the dipping fluid: there is still the cost of the supervision. It is obvious South Africa as a whole, and certainly Natal, has adopted a very complete system of control of the dipping tanks, more complete than we could hope for many years, but if we had

his figures it would give us something of value to our calculations. It appears clear that we could not get the sum of money to build tanks, nor the sum required to maintain them, and officers of this country are faced with the question "shall they wait until that day of idealism until money is obtainable or can something be done now." Cattle dipping originated in territory where individuals were in charge of large numbers of animals. Even in South Africa the ratio between cattle and people is high. The general ratio between cattle and people in Eastern Africa is roughly .7 of a beast to each of the population. Under these conditions, it does not appear entirely impossible to benefit by a system, which would be entirely impracticable, where there was only one person to many head of cattle. It is too much to hope for rapid results, but the propaganda has been going on in some countries, for example, in the German days, and more recently in Uganda: the results in Uganda are certainly favourable as the cattle are in better condition and the ticks are fewer, and gradually I am sure the mortality from East Coast Fever will decrease, but we cannot hope, as South Africa hopes, for eradication. We can only be optimistic with regard to control, and control to that extent, which will enable the Governments to gradually introduce susceptible sires for the betterment of the breeding herds. I do not think it is any good confining that propaganda to the distribution of circulars. What is necessary is an intensive and regular discussion with the owners, so that, when they have been told the same thing twenty or thirty times, they may go away thinking that the European is not such a fool as they imagined when he first told them to kill the tick. Very intensive propaganda should be conducted for one or two years and then I consider it would be fair to put a fine or penalty for any female tick which was found upon the native cattle. I had been hopeful that if all female ticks were destroyed for a period of two years, that for practical purposes, we could say that the generations had become extinct, but Mr. Power has pointed out that ticks remained behind somewhere and rapidly increased in numbers. Naturally hand-picking is not practicable in some of the pastoral countries where that ratio between cattle and people is different, and where there exist large herds of game. In such places, the construction of dipping tanks appear to be the only solution. Reference was made to Heartwater by Mr. Kennedy, who said that the mortality was not high. There does exist a disease of sheep in the Rift Valley known to the Masai as "enguruti" which is Heartwater. Sheep-owners of that neighbourhood claim that their losses from this disease range from 6% to 15% per annum according to circumstances. It is curious that this strain of Heartwater is only capable of inoculation by intravenous injection, but ticks infected here, and sent to Onderstepoort, reproduced the classical picture of Heartwater as known in South Africa. Mr. McCall mentions that few smears collected in enzootic areas show indications of East Coast Fever. When we first suspected the disease to be enzootic an officer, who was keen on cattle, keen on his job and a trained microscopist, was sent into one of the enzootic areas to make enquiries. He conducted over 15 post-mortems on calves which he considered to have died from this disease, and which the owners claimed to have died from this disease. He made over 200 gland smears from living calves, and from that large number only one smear from one post-mortem was positive, and that was from a liver smear. The difficulty of diagnosis in the enzootic areas appeared to be very great, and a negative diagnosis in the absence of an immunity test cannot be accepted. I shall ask you later to consider a resolution, which will urge upon all Governments for an intensified enquiry into East Coast Fever as it occurs throughout Africa.

Mr. W. Kennedy: Speaking generally, the number of ticks in a district depends to a considerable extent on the nature of the soil. On light soils, which do not crack to any extent in the dry seasons of the year, a lower tick incidence is more usual than on heavy soils, such as the black cotton variety. I attribute this to the effect of grass fires on tick life.

A custom of certain tribes, which results in controlling the infectivity of ticks, is that of grazing sheep ahead of cattle.

Mr. H. E. Hornby: Where so many points require elucidation I hesitate to emphasise yet one more; but one which has not been touched on, are the factors which influence tick infection. We all know how difficult it is to infect ticks experimentally. Sometimes larvæ or nymphs are readily infected; at other times whole batches of ticks feeding on infected animals fail to contract infection. To my knowledge no explanation of this apparently erratic variation in the behaviour of ticks towards the parasites has been given.

Dr. P. R. Viljoen: By the nature of my duties, I am extremely interested in the question of diagnosis of East Coast Fever. Mr. Power in his introductory remarks has laid great emphasis on the importance of early diagnosis of East Coast Fever. In South Africa, where the disease occurs in epizootic form, diagnosis is a comparatively simple matter, provided fresh organ smears are available. I am very interested to hear that in this country, where the disease occurs in enzootic form diagnosis has not by any means been an easy matter. I was surprised to hear that in cases of illness in cattle that were accepted to be East Coast Fever,

diagnosis from gland smears was only possible in about ½% of cases. I should very much like to have a definite expression of opinion from other Delegates present whether this is a common experience in this country, *i.e.*, whether infected calves commonly only harbour a few parasites, so few that microscopic detection becomes a difficult matter. This question interests me very particularly because, although Mr. Power has remarked that we are extremely hopeful of eradicating East Coast Fever from the Union within the next few years, one must always bear in mind the possibility—perhaps only a slight one—of the disease also assuming an enzootic character in parts of South Africa. For this reason, I should like to know a little more about the diagnosis of this form of the disease.

Mr. J. T. C. Bradshaw: Recently we had a small experiment going on at the Laboratory in connection with the treatment of East Coast Fever. Eighteen animals were exposed on a very heavily infected farm under the control of the owner of the farm. He was going to try a curative treatment for East Coast Fever after the disease had developed. Some of these animals started running a high temperature within 11 days of exposure to tick infection, and certainly in some cases, Koch's bodies were demonstrated fairly early after the incidence of the fever, but I must say that cases where Koch's bodies could be found early, were very few and far between, and a very careful search had to be made before they were found at all. In other cases, on the other hand, no Koch's bodies could be found at all, at the incidence of the temperature. In connection with this experiment, one found that in certain cases animals, even after starting a definite temperature reaction and showing Koch's bodies in gland smears, came back to normal, and subsequently had a second rise of temperature, which usually ended fatally; one beast I have in mind especially, who ran a temperature up to 106° on the 25th January and showing Koch's granules in smears, came back to normal and ran a normal temperature for over two months, yesterday (April 9th) that animal showed actual symptoms of a severe illness; further gland smears were made, and East Coast Fever infection was demonstrated, and I have no doubt that the beast is going to die, this, however, nearly two months after an actual positive diagnosis had been made.

I should like to ask Mr. Power, if in South Africa, altitude and climate have any connection with East Coast Fever infection, because, there is no doubt that on some of the high plateaux of this country, the farmers think that they are absolutely safeguarded against the disease on account of the altitude and the cold climate, *i.e.*, at Molo and on the Kinangop.

The Chairman: Do ticks occur there?

Mr. J. T. C. Bradshaw: There are brown ticks, but they are not so numerous as at the lower levels.

As regards laboratory diagnosis, one difficulty has occurred on several occasions recently, of a single case of East Coast Fever being diagnosed on a farm, and nothing further being heard of the disease after that. Usually, the farmer puts this down to a wrong diagnosis, or to a mistake in smears being exchanged at the time of numbering. I wonder if this frequently occurs in other countries. Instances of this sort have been noted even on farms that have not been dipping regularly.

I should also like to know the effect of constant dipping on work oxen.

The Chairman: In connection with the difficulty of diagnosis raised by Dr. Viljoen.

Mr. William Robertson records a case known to have been infected with ticks which never showed *Theileria* in its blood: daily examinations and post-mortems failed to show any *Theileria* present in the corpuscles.

In one of my experiments, I can recollect an animal which developed a temperature reaction about the 10th or 12th day, which ran the normal course: blood smears, gland smears, and organ smears, were all negative; and the animal died with every indication of East Coast Fever. It is recorded in one of my Reports of, I think, 1910.

Dr. P. R. Viljoen: I quite realise the difficulties. In some cases we have difficulty in arriving at a definite diagnosis, but up here apparently in the majority of cases the parasites cannot be demonstrated. In your remarks, Mr. Chairman, you referred to one very large outbreak in calves. You mentioned, that not only were gland smears made from about 200 calves, but, also that 15 of these animals were post-mortemed and that you found the percentage of positive diagnosis was only one out of the 15 cases. That is certainly astounding to anyone who is used to making diagnosis of ordinary East Coast Fever in dead animals. I do not think it really has ever occurred in South Africa that a diagnosis was not possible in such cases. Rarely in live animals, when only very few *Theileria parva* occur in the blood, or when gland smears are not properly made, difficulties may be encountered.

One other point I should like to raise in this connection, and I will put it more in the form of a question to Delegates present here, is, whether they have ever come across the so-called Koch bodies, or rather granules simulating those bodies, in animals which were undoubtedly not suffering from East Coast Fever, or in game. Once or twice we have had a little difficulty in the diagnosis of East Coast Fever, when only isolated Koch granules were present, so much so that after a few cases, the question cropped up whether there are bodies in animals—quite apart from East Coast Fever—so closely resembling Koch's granules that they cannot be distinguished by the experienced microscopist. I have often discussed this question with Sir A. Theiler who, as you know, has had enormous experience, and he himself is quite definite that in one case he found Koch's bodies, or bodies closely resembling Koch granules in a wild animal. I believe it was a buffalo. I should, therefore, be very much obliged to Delegates present here if they could perhaps relate similar experiences.

Mr. J. T. C. Bradshaw: I may say that recently two Indian buffaloes we had at the Laboratory, actually died of East Coast Fever, showing all the symptoms and lesions of the disease; Koch bodies and *Theileria parva* were numerous in organ smears.

Dr. P. R. Viljoen: In this particular animal I referred to, in connection with Sir Arnold Theiler's experience, there was no question of East Coast Fever.

The Chairman: In German East Africa Lichenheldt recorded finding bodies in a hartebeest and an eland—his Report is of about 1906 or 1907. In 1909 P. H. Ross, then Bacteriologist, Medical Department, Kenya Colony, obtained a smear, alleged to have been taken from a hartebeest, showing bodies indistinguishable from Koch granules.

In 1917 Mr. Hutchins sent me down smears, taken from two or three topi which had been shot in Western Uganda, containing bodies indistinguishable from Koch granules.

In 1912, Colonel Stordy, then Chief Veterinary Officer, Kenya Colony, went through the Northern Frontier, and sent down blood smears from Bright's Gazelle containing numbers of parasites, which were named *Theileria Stordii* and, about 1917 obtained for the first time an organ smear taken from a Bright's Gazelle. In that smear bodies indistinguishable from Koch granules were present. It does not appear impossible that game have an infection analogous to that of East Coast Fever. There is no proof that what they contain if passed to cattle would cause the same disease.

Indeed, cattle of these Bright's Gazelle areas are susceptible to East Coast Fever when they arrive here.

Dr. P. R. Viljoen: In my frequent discussions with Dr. Theiler on this very important question, he expressed a very decided opinion that these bodies may be—are likely to be part of the life cycle of another parasite altogether, and entirely unconnected with East Coast Fever.

I was wondering whether Mr. Knowles has seen smears, spleen and gland, from cases of Egyptian Fever, and if the disease is still present up there, whether he would be so kind as to send smears down to Onderstepoort, as we should be extremely interested to compare the two parasites.

Mr. F. J. McCall: I should like to corroborate the Chairman's remarks about the difficulty of diagnosis in the enzootic areas.

Mr. W. M. Power: Notwithstanding the favourable position of the disease in the South, we are not satisfied that the last word has been said in regard to East Coast Fever, or that tick eradication is the best means of eradicating it, though it is the best system yet devised. Experience shows that although tick eradication would appear to be the ideal system, it is certainly a slow process, owing to the practical difficulties met with. Therefore, I hope the suggestion will be made from this Conference that further research work be undertaken. I have mentioned that a start had already been made at Onderstepoort in that direction. Dipping has many advantages in a tick-infected country, and if it is the only solution of dealing with East Coast Fever, it certainly would have to be carried out with great thoroughness over a very long period. There is no better method known at present, and had it not been for that method, we certainly should not have been in the position we are in South Africa to-day, as regards the cattle industry. At the same time, experience and the long period over which we have been dealing with this disease, now emphasise the necessity for taking steps, in order to ascertain if some quicker means cannot be discovered.

Mr. F. J. McCall: Is there any appreciable difference in the mortality occurring amongst native cattle as compared to that encountered in graded or better bred animals of European blood?

Mr. W. M. Power: I do not think any appreciable difference has been noticed in the Union.

It has also been pointed out the difficulty of erecting tanks to provide for tick eradication among cattle in native areas. I have no doubt that these difficulties are very great, and certainly the scheme could not be lightly embarked upon without full consideration: the least of which is not that of expense.

If nothing better is discovered, and tick eradication is so essential in stock breeding countries that are tick-infested, the question might well have to be considered.

Mr. J. T. C. Bradshaw asked whether the altitude or the climatic conditions had any effect.

Mr. W. M. Power: That is a very important point: the disease was appropriately named tropical piroplasmosis. We find in Natal, that it is mainly in the low lying hot countries that the real difficulties are met with; in the clean, open country the difficulties are not nearly so great.

The estimate for this year in the Union is £70,000 for East Coast Fever supervision only.

Mr. J. T. C. Bradshaw also asked what was the effect upon working oxen.

Mr. W. M. Power: Certainly short interval dipping has an effect on working cattle, that is one of the difficulties, especially in the low and hot parts of Natal. In the busy season it is a great temptation to exempt them from dipping.

The same is true of milking cattle, short interval dipping does reduce the quantity of milk. Another of the factors that influences the farmer in extending the dipping interval.

Mr. J. T. C. Bradshaw also asked regarding isolated cases of East Coast Fever.

Mr. W. M. Power: We have had many of these cases where the disease has been diagnosed, and if in a clean area, it is a very difficult matter, if no further cases occur, to satisfy the farmer that that was East Coast Fever, he thinks that some mistake has been made in the examination or his smear has been mixed with another.

I am satisfied that further investigation is desirable, otherwise the final eradication of East Coast Fever may be further away than we may think. You will all remember how near Rhodesia has been to the entire eradication of the disease, also Swaziland, but something has always happened to put the clock back again. The Transvaal has several times been very near the goal. I do not claim Natal has been so near, but still, we have gone backward and forward in a way that suggests assistance might be obtained through further research work. I am not suggesting that the dipping measures should in any way be relaxed, it would never do now to go back on that position, and relax dipping in these countries where it has been adopted, in fact as already stated, dipping is necessary and should be encouraged in all tick infested countries.

RESOLUTIONS.

East Coast Fever.

1. This Conference is of the opinion that a Pan-African enquiry should be instituted in regard to East Coast Fever and allied infections, especially with a view to ascertaining the nature and cause of the immunity enjoyed.

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2. This Conference considers that efficient tick destruction will eradicate East Coast Fever, and other tick-borne diseases.

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3. This Conference is of the opinion that East Coast Fever can be eradicated by regular dipping under proper supervision, in the standard strength of arsenical solutions for dipping at intervals of three or five days.

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4. This Conference considers it desirable to undertake further research into the possibility of using a non-poisonous dipping solution for the prevention of tick-infestation.

A. SPECIFIC ANIMAL DISEASES.

(4) Trypanosomiasis.

Tsetse Bionomics.

Mr. U. F. Richardson (Veterinary Pathologist, Uganda): The subject of Trypanosomiasis, unlike Rinderpest, is anything but satisfactory. There are so many gaps in our knowledge, and so much difference of opinion, that even theoretically no clear line of action seems indicated.

I believe all the countries, which we represent, are affected to a greater or less degree by the diseases falling under this head.

I believe that, at any rate in the tropical countries, as our knowledge of stock problems increases, and as the countries develop, those diseases will assume greater and greater economic importance.

That at any rate has been our experience in Uganda, and, so great is the uncertain quantity represented by these diseases, that in a large part of the Protectorate it is with great hesitation we recommend investment of capital in the stock industry until better methods of control are available although we know that the country is otherwise suitable and in the past has carried a very large cattle population. In Uganda the economic importance of these diseases is confined to cattle. What the annual loss in cattle has been it is hard to say, as so many cases escape detection and record. As a rough estimate, independent observers have given a figure of 10,000 head. We must add to this the continual losses which occur in cattle transport (our only cheap form of transport). There is I think hardly an owner running transport to our main ports on Lake Victoria who has not suffered, at least once during the last 10 years the complete loss of his transport oxen. Although some of the main cattle districts have hitherto escaped we cannot guarantee that they will have any permanent immunity, or, that if once the disease is introduced it would not spread as freely as it has done in other districts.

In Uganda there have not been up to the present very many facilities for differentiation of Trypanosomiases.

In cattle we recognise three types of Trypanosomes: *T. brucei*, *T. congolense*, and *T. vivax*, with a sub-group of *T. uniforme*.

These groups can be differentiated by Morphology. Trypanosomes, which vary somewhat from the main type (*e.g.*, in animal reactions) we are inclined to regard as strains rather than distinct species.

Virulence. *T. brucei*: non-pathogenic to cattle. *T. vivax* causes loss of condition and milk in cattle. In the field it has been held responsible for heavy losses, but in animals kept under prolonged observation under ordinary conditions at Entebbe, it has not caused a single death. *T. congolense*: Usually proves very fatal, running a course of about two months. We had thought the mortality nearly 100%. I have now got a strain which appears avirulent.

The loss in Uganda can be put down to two causes: (*a*) extension of tsetse areas; (*b*) the spread of the disease in areas believed to be tsetse free. Of these, the second is the most important. There may be undetected tsetse areas, but a large number of outbreaks have been investigated in which tsetse have not been discovered, and in Kampala, the main town, where Trypanosomiasis outbreaks have occurred constantly during the last 10 years, it is almost inconceivable tsetse can be held responsible. Dr. Aders informed me, that in Zanzibar a large percentage of the cattle show a Trypanosome of *T. congolense* type, yet there are no tsetse in Zanzibar. Usually outbreaks in non-tsetse areas become most noticeable after the extension of a fly-belt and the consequent movement of cattle.

Transmission. In the absence of tsetse, we, following observations elsewhere, have accused Tabanidæ and Stomoxys as transmitting the disease mechanically. Tabanidae are, however, often so few in numbers, as to make it impossible to believe they could be responsible for all cases, and we have fallen back on Stomoxys. In a recent outbreak in Kampala about one-third of the cattle in and round the station were found infected, though they had been regularly dipped. We know that infected cattle have been taken into stations in which Stomoxys are prevalent without causing outbreaks. In outbreaks, in which tsetse are apparently not involved, the disease usually only attacks adult cattle. Dogs, goats and calves up to 18 months old seem never to become infected. I have had counts made of the Tabanidæ on adults and calves, and although slightly more numerous on the adults, it would hardly explain the freedom of the young stock. Stomoxys certainly attack young stock readily. Further research on the question is being undertaken.

Methods of control and diagnosis: In the absence of tsetse, we endeavour to remove the infected animals. In many cases a measure of success has been obtained. One herd, treated in this way in 1910, has remained free from the disease in the same area up to the present time. The difficulty arises in detecting the animals which are infected. By microscopic examination of the blood in recent cases, *congolense* and *vivax* infections, can usually be detected. In older cases *T. congolense* has escaped detection in the blood for two months, and *T. vivax* for three months, after daily examination. By this method we can, therefore, only hope to remove a proportion of the cases. It requires a lot of time, and in practice would need a very large staff if all outbreaks are to be dealt with. Gland puncture has given no better result than blood examination. Since, however, success has been obtained in certain favoured herds by blood examination it would seem that, if a reliable method of diagnosis could be obtained, the disease could be eradicated from areas in which tsetse do not exist and one would only have to consider the possibility of further infection from tsetse areas.

Treatment: We have tried treatment for *T. congolense* and *T. vivax* by various methods, but the only one which gave a good result was tartar emetic intravenously. As some of the animals treated have been under observation for two or three years afterwards, it appears a real cure was obtained. In one case, a relapse was reported after five years, and one after two years. These were, however, possibly re-infections. We decided, that as a cure could not be guaranteed in every case, and apparently cured cattle might relapse and become a danger to others, it was best not to undertake treatment except experimentally. In any case, the course of treatment required is too protracted to make it possible to undertake it on a large scale.

Immunity: Apparently animals naturally recovered from *T. vivax* infection can be re-infected with a strain of the Trypanosome obtained from the original outbreak from which they recovered. These might be relapses, but the re-appearance of trypanosomes after inoculation had the usual incubation period.

The Tsetse Fly: *G. palpalis*. This fly readily conveys *T. vivax* and *uniforme*, but does not seem to be an important factor in the carriage of *T. congolense*. It can be made to transmit this in the laboratory and I am at present conducting experiments as to how readily it transmits in natural conditions. Field experience, however, seems to indicate that it does not readily do so. With regard to *G. morsitans*, *pallidipes* and *fusca*: During the last 15 years in Uganda serious extension of areas, infected by the first two species, have been reported, and one case of retrogression. The extensions seem usually to follow the migration of the population from surrounding areas. The case of natural retrogression is interesting. It followed after the Rinderpest wave, but its connection with it is doubtful as the same did not occur in the other areas. It is unfortunate no officer was available to investigate the causes of this retrogression immediately it was reported.

The Chairman: Gentlemen, we are favoured to-day with the presence of the Principal Medical Officer for Kenya Colony, and I would ask him if he would be so good as to inform the Conference of any recent work carried out in connection with Human Trypanosomiasis or the Bionomics of the Tsetse.

Dr. J. L. Gilks: Mr. Chairman. As regards this Colony little or nothing has been done during the past two years with regard to either tsetse or trypanosomes.

There is a certain amount of Sleeping Sickness which still goes on around the Lake, but at the present time not very much, and that is chiefly confined to two or three small areas.

I think the most important work I have seen lately is published in a recent copy of the *Bulletin of Entomological Research*.

I take it you do not want me to restrict my remarks to this country.

Most important work has been done in Tanganyika by Swynnerton and by Duke of Uganda, on an outbreak of Sleeping Sickness, which has occurred there, in the past few years, just across our border, and the account of the investigations is very interesting reading. It traces the beginning of the outbreak from about 1918 and the conclusions are very strongly against the destruction of big game, which has been advocated as a means of eradicating the tsetse fly elsewhere.

In 1918 not only was there influenza, which debilitated the natives very considerably, but famine also existed. The people in the area were forced to kill the game animals for food. The result was, that the tsetse was compelled to fall back on humans as its chief food supply. The constant attacks of the tsetse fly on the debilitated human population resulted in the breeding up of a type of the *Brucei* trypanosome which became pathogenic to humans. The trypanosome itself is apparently identical with the *Rhodesiense*.

There is a very interesting description of the conditions as found in the district. He describes the villages and the densely-infested bush, and he shows that the whole population live under a condition of being continually bitten by tsetse flies in these areas. The fly belongs to the *morsitans* group.

It is suggested, that to deal with the area, the population should be concentrated in localities on the borders of the bush and that their activities in the shape of wood cutting, tilling of shambas, etc., should be regulated in order to extend the fly-free area by destruction of the bush.

Mr. H. E. Hornby: I am entirely in accord with everything Mr. Richardson has said, and it is an indication of progress when workers in several parts of Africa agree on so many points of this subject, because ten years ago there was extraordinary diversity of opinion on all points. Then the nomenclature was in an absolutely chaotic state; to-day there is a tendency towards the use of a common one. So far as cattle trypanosomes go the names used by Mr. Richardson cover all the more important African species, and are generally accepted as valid.

The question of mechanical transmission was, ten years ago, by no means universally accepted, while to-day all recognise its occurrence. Mr. Richardson states that Stomoxys are probably vectors, but he adds a rider that fly-struck animals may be introduced into herds parasitised by Stomoxys and yet the disease may not spread. That is my experience, and while I consider that Stomoxys in common with all other blood-sucking flies are possibly occasional transmitters of trypanosomes, yet this genus is less important in this connection than are the various genera of Tabanidæ. My experience indicates that the disease is rarely maintained indefinitely by mechanical transmission only. Where mechanical transmission is most important, is in areas which are 10 to 20 miles from a permanent tsetse fly belt. The disease is re-introduced or introduced for the first time by animals infected by tsetse, and is maintained for some time by mechanical transmission, but it does not usually happen that 100 or more miles from a tsetse area the disease is maintained, even when mechanical transmitters are present in considerable numbers. The explanation, I think, lies in the fatal nature of the disease. Native tended animals, as we all know, when sick from almost any cause are so badly nursed that they die, and that is so in Trypanosomiasis; the infected animals die out during the dry season when biting flies are absent. If the disease were not fatal, it could, and would be maintained by mechanical transmitters only, and it is of interest to ask if that condition occurs in Zanzibar to-day, where the Economic Biologist maintains, occurs a strain of only mildly pathogenic *T. congolense*.

Mr. Richardson pointed out how in various parts of the country, you get different effects following infection with apparently the same Trypanosomes. That is the case everywhere. Generally speaking, *Trypanosoma congolense* is very pathogenic for cattle, but there are areas where either this tryponosome is less pathogenic, or cattle are less susceptible, because the mortality which results from infection is low. The *Trypanosoma vivax* is generally less pathogenic than the smaller species, but undoubtedly many cattle succumb to natural infection. *Trypanosoma brucei* is not pathogenic for cattle, but bovines may harbour the trypanosome and so be carriers, and this eventually has to be considered in connection with Sleeping Sickness, when the subject matter is the identity of *Trypanosoma brucei* with the parasite known to cause sleeping sickness in man.

In connection with treatment, no mention has been made of "Bayer 205". We are all aware of the success claimed by Germans and others who have used this drug in the treatment of Human Trypanosomiasis, and we are also in possession of information that B. 205 is not of corresponding value in the treatment of Trypanosome infection of cattle. This is interesting; as confirming further the vast differences, other than morphological between the monomorphic and the polymorphic trypanosomes.

We hope, that if it be confirmed, that B. 205 is of great value in treating human Sleeping Sickness, it will be found to give equally good results in the treatment of horses and dogs affected by *T. brucei*.

Finally, a point of great importance is the question of immunity. It is useless to attempt to set up an artificial immunity greater than can be found in individual animals in a state of nature, and so I should like to emphasise the necessity for a thorough investigation of the state of immunity which is alleged to occur amongst various local races of cattle throughout Africa. If the immunity of these local races be real, we might use them in fly-belts, or at any rate a study of their immunity might point out some direction along which we can best essay the task of artificial immunisation.

Mr. F. J. McCall: It is estimated that approximately 200,000 square miles or about one-half of the Tanganyika Territory, on account of glossinæ, is rendered unsuitable for domesticated animals. In these fly zones are included many of the most fertile districts of the Territory.

It is not intended to convey the impression that tsetse fly can be captured any day on every square mile of these areas, but merely to indicate, that the successful breeding and rearing of domesticated animals cannot be carried on with any degree of safety, and it is not attempted by the natives who inhabit these regions. Glossinæ may be here to-day and gone to-morrow, their movements being influenced by such conditions as season, shade, rainfall, grass fires, presence or absence of game and presumably by many other factors, the true inner significance of which has not yet been fully grasped.

Distribution of Tsetse. (1) The Coastal Fly Zone. While fly-belts of various dimensions are encountered throughout the country, the most important undoubtedly is that which constitutes the hinterland of the coast area. This zone, 150 miles deep behind Tanga, runs inland along the foothills of the Usambara and Pare Mountains, as far as Kahe and Moshi on the slopes of Kilimanjaro. It connects with the fly areas of the Pangani Valley and continuing down the coast hinterland becomes more constricted, but still extends as far as Handeni; narrowing opposite Zanzibar, it subsequently increases to a depth of approximately 200 miles behind Dar-es-Salaam where it reaches inland as far as Kidete on the Central Railway. From Dar-es-Salaam southwards it gradually widens, until at the Portuguese border, it attains its maximum width of fully 300 miles. It is estimated that not more than 20,000 head of cattle are to be found in the whole of this area, although it includes about one-fifth of the entire country; where cattle are found, they are restricted to the coastal towns and to such localised fly-free places as Mahenge, the Uluguru Hills and the occasional small, isolated patches, which occur at wide intervals throughout the zone. A few cattle are also kept on the islands of the Rufiji Delta. The greatest length of this zone is about 500 miles, its greatest width about 300 miles.

(2) Western Zone. The above designation has been applied to a fly area, which in extent is greater and in importance almost rivals the coastal zone, from which it is divided by the highlands of the interior. Commencing west of the Lake port of Mwanza, it embraces the western half of the southern shore of Lake Victoria, and runs north into the Bukoba district for a distance of 40 miles. Southward, it pursues an unbroken course through the entire length of the Tabora district and crosses the Central Railway, then southward over the Ugala River to a line approximately seven degrees south of the equator; it embraces the shores of Tanganyika for a distance of over 100 miles south of Ujiji, the terminus of the Central Railway. Northward, it thrusts an arm along the west bank of the Kagera, into the Bukoba district. The greatest length of this zone is about 500 miles, its greatest width about 350 miles. Eastwards, it reaches to within 30 miles of Kilimatinde in the Dodoma district, while southward, it extends to Lake Rukwa and the border of the Rungwe district.

As will be readily understood the whole of this area is not a solid tsetse belt, but contains numerous islands of glossinæ-free country, these however, are very inconsiderable in extent as compared to that which is infected.

(3) Ikoma Zone. This is the last large glossinæ area to be enumerated and is situated in the district of that name. Its greatest length is about 100 miles, its width about 70 miles, it stretches for about 20 miles north of Ikoma to about 100 miles south and reaches the shores of Eyasi, westward it abuts on the Lake Victoria and eastward, it ceases on the Serengeti plains.

(4) Victoria-Nyanza Lake Zone. Much of the country immediately bordering Lake Victoria is free from tsetse, more particularly along the eastern shore, and large herds of cattle can be seen grazing on the water's edge. Many areas, however, are infested, more especially at the mouth of the rivers and streams. The interior of Ukerewe Island is infested and the Veterinary Officer of the Lake Area reports that cattle cannot be kept in the centre of the island, but are restricted to the neighbourhood of the shores.

In addition to these areas, numerous small belts are scattered throughout the territory, of which the best known are those at Kondoa Irangi, Meatu, Mkalama, Eyasi, Ufiome, Manyara, Tarangire, Natron, Arusha, Mgera, Shamerai, Amara, etc., these, however, are purely local and are isolated from the main zones.

Expansion and Contraction of the Fly-belts. Undoubtedly tsetse are being recorded with disconcerting frequency in places wihch were formerly believed to be free from the pest, and the question arises, as to whether the presence of these glossinæ indicates the occurrence of a fresh invasion into clean areas, or merely the discovery of pre-existing fly-belts hitherto unrecorded; probably a combination of both conditions is in operation. On the one hand, it is definitely known that in certain areas the fly-belts have extended to an alarming extent; for examples of this nature it suffices to quote the Mkalama-Mbulu road, the Meatu belt, and the new centre which is actually developing along the Oreteti watercourse to the south of Kitumbene in Arusha. On the other hand, it is recognised that the entomological survey of the territory is most incomplete and that many areas at present looked upon as doubtful will ultimately prove to be infested to a greater, or lesser, extent.

For this reason it is advisable to be guarded, in advancing any definite opinion to the effect that the fly is markedly on the increase.

Turning to the hopeful aspect of the case, we do know, that much of the best cattle country now ranged over by the 7,000,000 head of stock of the territory was at one time bush and forest land, continuous with known tsetse belts, and we can to-day see the tramping out, clearing, cultivating and converting process at work in many extensive areas. In this respect Singida, or the open Mwanza plain, stretching up to the verge of tsetse bush, afford good examples of what is actually taking place in many districts; on the one hand a vista of grazing lands dotted with huts and speckled with cattle, on the other a tangled wilderness. Year by year the trees on the fringe are cut down, new fields are cleared, the sheep and goats follow, the cattle come by and by, the open plain extends, and the bush with its tsetse recedes. In my opinion, the solution of the glossinæ problem lies not in our day but in the future, in the increase of the people, the flocks and their herds. Increase of people itself will not suffice as native cultivated lands will speedily revert to jungle, and carry an even denser growth of bush than formerly, unless tramped down, browsed, and grazed over by the domesticated animals of man. Grass fires and game destruction are undoubtedly adjuncts, but can only be regarded as such. It may be advisable to replant areas in the reclaimed grazing lands for fuel and for purposes of water conservation, but, in that the tsetse problem only to a minor extent affects the valuable timber and rain-belt forests of the higher altitudes; this aspect of the case is not likely to give rise to serious trouble.

The economics of the removal of dwindling herds and villages from small free islands in the midst of the encroaching tsetse, and their re-establishment on the fringes of the larger, more vigorous communities, which numerically are powerful enough to retain the bush and extend the clean area, is a fascinating subject on which to speculate. It is reasonable to assume, that at some future date, action of this or a similar kind will be taken, which will profoundly affect the problem.

Species of Glossinæ encountered. While various species are found throughout the territory, the *G. morsitans* group is the common tsetse of the country; more particularly is this so in the coastal zone and all areas south of the Central Railway. The next most widely scattered and commonly encountered is *G. pallidipes*, and *G. brevipalpis* probably ranks third in this respect. *G. longipennis* has been recorded in the Kilimanjaro area, *G. fusca* from the Amara Valley, while *G. austeni* has been taken in several localities. A recently identified species *G. swynnertoni* has been discovered in the Mwanza area.

The above pronouncement regarding the distribution of glossinæ in the territory is only a general statement, as in some areas physical conditions differ to such an extent, that within a few miles *G. morsitans*, *G. pallidipes*, *G. brevipalpis* and *G. austeni* can all be taken without difficulty.

It would seem, that in certain instances the strict adherence of tsetse to belts or definite localities as recorded by some writers on the subject, has not been observed as altogether constant with regard to *morsitans*.

I was very much interested to hear the remarks of the Principal Medical Officer in connection with work done in Tanganyika, especially as I have travelled through most of the country referred to and have frequently discussed the question with Mr. Swynnerton, whose recent report (referred to by Dr. Gilks) is in the *Bulletin of Entomological Research*.

As the Principal Medical Officer remarks, Swynnerton advances the hypothesis that the tsetse in absence of their usual food supply, viz., the game, turned their attention to the human population and that the trypanosome, which had hitherto been restricted to game accommodating itself to altered conditions, became pathogenic to man. The hypothesis is a fascinating one, particularly so to the Game Warden offering as it does a reason for restricting game destruction. We, however, as veterinarians are more interested in the increase of the flocks and herds, than of the wild animals, and I feel convinced that the influence of the domesticated animals of man as affecting the problem is of primary importance.

In Dar-es-Salaam recently, a serious outbreak of trypanosomiasis occurred amongst dairy cattle. Tsetse can be captured in the vicinity of Dar-es-Salaam, but not in any great numbers, yet the dairy cattle were heavily infected and it would seem that stomoxys were chiefly incriminated. Routine inoculation with tartar emetic, one gramme once a week for seven weeks, was carried out and the animals certainly improved in condition. The causal organism was *T. vivax*.

Microscopic examination of the blood of an imported cow (Ayrshire), observed to be in poor condition, revealed the presence of trypanosomes of the *vivax* group. One gramme of tartar emetic was administered intravenously each week for seven weeks and to-day she is fit and well, has reared her calf and is in calf again.

There is reason to believe that stomoxys and tabanidæ may at times be instrumental in spreading trypanosomiasis from animals infected in the fly-belts to clean cattle by mechanical transmission, but the bulk of evidence on the point would appear to indicate that although undoubtedly frequent this cannot be the really common method, as were it otherwise few cattle could escape infection, since stomoxys and tabanidæ are ubiquitous and few herds on the borders of the fly-belts have not at least one trypanosome infected animal in their midst.

The possibility of introducing Indian Buffalo and crossing these with the indigenous species is under consideration, and it is thought that if this can be done, and if the calves resulting from the cross can be reared in the fly-belts, the production of a breed suitable for transport in glossinæ areas may be evolved. We do know that the wild buffalo can live and thrive in the worst tsetse infested country, and it is thought that every endeavour should be directed towards its domestication, as also towards the finding of relatively tolerant breeds of cattle.

Mr. U. F. Richardson: I cannot agree with the view that mechanica transmission is only of secondary importance and will not become permanent During the last ten years there have been many outbreaks of the disease in Uganda, but I know of only one single instance in which the district involved became clean, and that only by the practical extinction of the cattle.

Mr. W. M. Power: I think there is no doubt that there is mechanical transmission taking place in and around infected areas in Zululand. I have seen many cases of Nagana come out of these areas, and been taken to different parts of Natal, but no spread of disease has taken place. In fact, so far as I am aware, there has not been a case which could be attributed to mechanical transmission far away from the actually infected areas.

Dr. J. B. Botelho: The areas of trypanosomiasis are many in the whole of the Province of Mozambique, chiefly to the north of the River Save which abounds with glossinæ. It can be said that in this part of the province clean areas are very rare. Mozambique, Quelimane and Tete have great and numerous areas of glossinæ, and also the territory of the Companhia de Nyassa. Away from the areas where glossinæ are found, cases of trypanosomiasis have been diagnosed in almost the whole of the district of Inhambane. The trypanosome found is of the type *pecorum* or *dimorphon*.

In the district of Gaza, after complete removal of the whole of the cattle from Chair-Chai and Muchopes in 1909 and 1910, not a trypanosome was found in the cattle afterwards introduced there to reconstitute the herds.

In the district of Lourenco Marques, the only area of trypanosomiasis is the southern part of Maputo, facing Zululand. Until November, 1922, no glossinæ were found in this area notwithstanding many and frequent searches to this effect.

In October, 1921, I was informed by the Nagana Research Laboratory, Zululand, that at Nyamiti Pan, two miles to the south of the River Usutu, and near the frontier of Maputo, a *glossina brevipalpis* was found.

I advised my Government to take some measures, such as extermination of big game, clearing of the forest in the region threatened by invasion, etc., measures which unfortunately were not put in practice owing to various reasons. At once I ordered a close search to be made on the border in order to discover any glossina. In November, 1922, one *glossina brevipalpis* was found in Katune region, facing Zululand, but afterwards in spite of repeated searches made in that region, no other specimen was found until I left Lourenco Marques. On the 7th May, 1918, at the Experimental Farm of Umbeluzi, the death was reported of one of the cows, imported in 1910, from Cape Province. By microscopic examination of its blood smears, I found *T. pecorum*. No animal from the infected areas of trypanosomiasis had entered that farm, as all the animals introduced there came from the Union of South Africa and were destined to improve the breed. Having continued my researches, I was convinced that trypanosomiasis could only have been introduced there by waterbucks abounding in the infected area of Maputo, between which area and the farm several cases of trypanosomiasis were discovered. Having examined by microscope blood smears of the remaining oxen on the farm, it was found that almost all the remaining animals were infected: so all of them were slaughtered, and the farm closed up. In the neighbouring farms some cases were registered, having also killed all the infected animals. Since then, blood smears of the remaining oxen of those farms have been systematically examined by the microscope, but so far no more trypanosomes have been found.

The animals recognised as infected did not show any apparent clinical symptoms.

The species of the glossinæ so far found in the northern districts are the following: *Gl. morsitans*, *Gl. fusca*, *Gl. pallidipes*. The first species being the most abundant.

The only measures taken have been, (*a*) extermination of animals recognised as infected; (*b*) subjecting to quarantine the areas where cases of disease were registered, not allowing any movement of cattle to, from or through the said areas.

Mr. W. KENNEDY: We have most of the recognised tsetse flies in this Colony including *G. palpalis*, *G. pallidipes*, *G. longipennis*, *G. brevipalpis*, *G. fusca* and *G. austeni*. Trypanosomiasis is not such an important disease here, however, as those we have been discussing, viz., rinderpest, pleuro-pneumonia or East Coast fever.

With regard to Mr. McCall's remarks on the value of cattle in causing the disappearance of bush, I take it that he was referring to up-country conditions, since my experience in this Colony has not led me to believe that cattle have any marked effect on the jungle existent in many of our coastal areas.

In some instances, where infected animals have been moved from tsetse fly areas to clean areas in this Colony infection has spread, presumably by mechanical transmission, to other animals in the clean area, but, on the other hand, similar movements have occurred without resulting in the spread of infection. It would appear that, if movements of this nature are carried out during the seasons when hæmatopota and tabanus are numerous, there is a considerable risk of the disease being transmitted mechanically. Our endeavour, at present, is to control the spread of the disease in clean areas rather than to attempt to deal with the disease in tsetse fly areas.

An extensive outbreak of trypanosomiasis occurred in the Thika District in 1915, and was successfully dealt with by restricting cattle movement from infected farms, and by the slaughter of all infected animals. Another outbreak occurred in the same area about six months ago, and we are attempting to deal with it without slaughtering infected animals. The principal difficulty experienced in the Thika district is to ascertain definitely which farms are in the tsetse fly zone, and which are outside of it. If we possessed definite information on this point, I think the disease could be kept under control to a considerable extent by prohibiting movement from within the tsetse fly zone.

We have no evidence in support of the view that cattle become immune to trypanosomiasis. The cattle found in our tsetse fly areas are certainly tolerant but remain infective.

Mr. H. E. HORNBY: With regard to Mr. Kennedy's remarks, I think, if he fails to make any use of medicinal treatment, he is losing a valuable aid to eradication, for apart from the curative value of tartar emetic injections, undoubtedly for a few days after the animal has received an injection, its blood is entirely, or almost entirely free from trypanosomes, and it is not a danger to the others with which it is grazing. I have had to deal with very many European-owned herds affected with trypanosomiasis. My routine was to segregate all those clinically affected, for treatment or for slaughter and also, provided the number was not too great, to inject with tartar emetic all the remainder. This gave me time to turn round, because I knew that after these injections there was not much danger of fresh cases originating for a week. After that, immediately any animal of the "sound" herd showed any signs of the disease, whether diagnosis was confirmed microscopically or not, it was removed to the infected mob for systematic treatment. If these measures be only applied thoroughly, it is not difficult to clean a herd of the disease. As with all other diseases it is the short cuts the owners try, or else negligence, which spoils the results.

Mr. W. KENNEDY: In connection with Mr. Hornby's remarks I would mention, that we have carried out treatment with tartar emetic on a small scale in this Colony. The main difficulties to be overcome are the numbers of cattle which can be dealt with by one veterinary officer, the large areas over which the cattle are frequently scattered and the fact that the blood is only freed from trypanosomes for a short period by this treatment. What number of cattle does Mr. Hornby think a veterinary officer could deal with on a farm, and how long would it take to deal with an outbreak by this method?

Mr. H. E. HORNBY: I have had to adopt the procedure, necessary in sparsely populated countries, of instructing laymen—stock officers, farmers and even natives—in the use of tartar emetic injections, and if they were conscientious and intelligent good results would be achieved, even where the herd ran into hundreds. It is a matter for co-operation. The veterinary officer can do little if those whose cattle he is treating do not give him all possible help. Early diagnosis and the removal from the mainly unaffected herds of all animals shewing any signs whatsoever of the disease are essential measures. Hard work for two months, and careful watch during the next ten, are necessary to clean a large herd.

Mr. U. F. RICHARDSON: Has Mr. Hornby tested by sub-inoculation whether the blood is free from trypanosomes?

Mr. H. E. Hornby: I cannot remember having done so, but the immediate reduction in the number of trypanosomes which follows injection is most striking. I have not had the necessary animals to do inoculations, but I do not remember ever finding trypanosomes microscopically within five days after inoculation. The number of recoveries which have followed even single injections indicates the sterilizing nature of the treatment.

The Chairman: It appears clear from the debate so far, that there are two types of country to be considered in connection with trypanosomiasis, one is the district permanently tenanted by various species of tsetse, and its immediate neighbourhood; and the second, is the areas removed from these permanent zones, wherein the transmission, we call mechanical, is going on.

At the 1909 Conference, there was considerable discussion on the part of the Rhodesian representatives with regard to the so-called mechanical transmission, and it was said, that it was quite safe to introduce an animal into Southern Rhodesia, whose blood contained trypanosomes, since they did not know of any transmission having resulted therefrom. Yet we do know, of course, that transmission in the absence of tsetse does occur. One has only to look at the map of the world to see that trypanosomiasis occurs in such countries as South America, India, and the Far East where tsetse are absent. We are morally certain also, that there are no tsetse on the island of Zanzibar where trypanosomiasis occurs under natural conditions. May it not be, as has been discussed in connection with ticks and East Coast Fever, that there exist areas wherein for climatic and telluric reasons there is a natural tendency towards mechanical transmission.

You may remember the work of Kinghorn and Yorke in Northern Rhodesia, where they attempted the transmission of a human strain of *gambiense* by means of *Glossina morsitans*. These experiments were conducted on the high plateau and the fly did not become infected, but when they were repeated a few miles distant in the valley below the escarpment, in the warm, moist atmosphere, the fly did become infected. Subsequently, on return to the plateau the fly became infected when kept in an incubator under certain conditions of temperature.

On the island of Zanzibar there are two distinct types of soil, a coral and arid one on the one side, and a thick, heavy loam on the other. Trypanosomiasis is more common on the latter side of the island. These points reflect the possibility of an intimate connection between the various biting flies and the trypanosomes which we do not at the present time understand.

It was asked by Mr. Hornby whether any area 100 miles distant from the tsetse zone is affected by mechanical transmission. I think there are areas in Uganda that distance from known *morsitans* belts where outbreaks have occurred. I carefully exclude *palpalis*, because it is not known to have any connection with the *Trypanosoma congolense*, in natural outbreaks of East Africa. It is very important to Uganda to definitely establish this field observation that *Gl. palpalis* is not a natural host of *T. congolense*. The whole lake shore of the mainland and islands are heavily infected with this fly. In the repopulation of the islands which is now proceeding, stock are returning, and in spite of careful examination a bovine so infected may escape detection, thereby if proved capable, establishing the disease as a permanent menace. It is possible that certain trypanosomes do not multiply in certain tsetse. Some years ago I sent a strain of *T. evansi* from a camel of the Northern Frontier to Dr. Duke at Entebbe, and he failed completely to cause *Gl. palpalis* to become cyclically infected.

Dr. Gilks, in speaking of human trypanosomiasis in the Mwanza district, indicates the view that the cause was originally a game trypanosome which had become habituated to man. The various strains, which have been maintained in the European laboratories through very many generations retain in the main the same morphological and pathogenic characters though slight variations may occur. For example from 1896 to the present day *T. brucei* remains approximately uniform. Dr. Duke is endeavouring to cultivate strains and introduce modifications by experiments. I support Mr. Kennedy with regard to the tolerance of local races of cattle, and I do not think it should be considered an immunity. We do not know yet that the introduction of other cattle to the neighbourhood results in death, or that they themselves survive if moved.

The importance of cattle in the neighbourhood of the tsetse zone cannot be overestimated. In Uganda since the rinderpest, and the destruction of the game and cattle, the bush has grown up and the areas of the tsetse have extended very considerably. It is an enormous problem to tackle the known tsetse areas, but certainly it will have to be faced, if the territories we are interested in require more land. With facilities for examining microscopically and of sterilizing the blood of infected beasts the infection should die out in areas where mechanical transmission occurred. It is only a question of applying the knowledge we have to-day. For the tsetse areas we want more information.

Uganda derives its prosperity at the present time very largely from cotton. We are all told that no more can be grown, because the time of the people is now taken up in hand cultivation and in moving the cotton from the place of growth to the markets. The answer is the substitution of cheap animal transport for the human form. This appears to be the only practical solution as mechanical transport cannot be seriously contemplated in all districts.

I am equally interested with Mr. McCall in the domestication of wild animals for use in the tsetse zones. The experiment must be tried, however, before an answer can be given, but we cannot forget that where wild animals have been experimentally infected they have died. It may be that a local tolerance exists similar to that of certain races of cattle, to which we referred.

A further point came forcibly to our mind during the late war, surveys were conducted for the presence of tsetse fly before certain movements of animals took place. I would emphasise that it is not only the presence of tsetse we want to know, but the percentage of tsetse which are infected, and the species of trypanosome which infect them. It is conceivable that areas occur where only forms exist to which, presumably, equines and a number of cattle would be safe. If *T. brucei* is the dominant infection, then you would know at once that horses would be out of the question.

Mr. Kennedy refers to the local outbreak near Thika in 1916. This infection was due to one of the *congolense* group, the average duration of naturally infected and experimentally infected bovines was 42 days. Equines artificially infected with the strain contracted infection, but the majority recovered, and even to-day some of those horses and mules which were infected are being worked at the Kabete Laboratory.

In order to demonstrate the possibility of mechanical transmission, cattle were sent from the laboratory and they did not leave the vicinity of the sisal factory, with the result that they became infected by contact with the naturally diseased animals.

Transmission in the absence of tsetse was, therefore, demonstrated there, as in many other instances.

Dr. P. R. Viljoen: Although I have not had much personal experience in South Africa in dealing with trypanosomiasis it would perhaps be interesting for you to know what has been done there recently in connection with our investigations in Zululand. Before proceeding to give you information on Nagana I would mention at this stage that another trypanosomiasis in animals, caused by *Trypanosoma equiperdum*, is also prevalent in certain parts of South Africa, and that, in fact, it appears to be a more serious problem than Nagana.

Nagana is confined to Zululand at present. The most common trypanosome is *T. congolense*. The disease occurring most commonly in cattle. A year or two ago it was found necessary to start an experimental station in Zululand. The reason for this was that Zululand was opened to a number of settlers (returned soldiers) who naturally took with them a good many cattle, transport oxen, etc., and experienced heavy losses. I may say that until a few weeks ago tsetse fly could not be found at all in the settlement and the Officer-in-Charge came to the conclusion that there also, transmission was taking place in a mechanical way by flies other than tsetse. Sir Arnold himself could not be reconciled to this idea, but was of the firm conviction that tsetse must be held responsible for transmitting the disease in Zululand. In order to make quite sure whether or not tsetse flies were present, and had escaped the notice of the farmers, further experiments were undertaken. The result was that a few weeks before we left the Union, tsetse flies were actually found in that area.

I have not sufficient practical experience to discuss the question of mechanical transmisson, but from what has been stated here this morning, especially by our Chairman, it would appear in certain cases there is very little doubt that this takes place. Mechanical transmission is recognised as taking place in some forms of trypanosomiasis.

In the other disease I am going to speak about later, viz., dourine, this is the natural mode of transmission.

As regards Nagana, the results of our experiments have been to confirm very largely the experience of other workers with the use of tartar emetic in the treatment of trypanosomiasis in cattle. The results of the treatment were entirely satisfactory, so much so that one can almost say with certainty that the blood of treated animals has apparently been completely sterilised. In several cases this has been tested by injection of blood of treated animals into susceptible small animals, the result being that no parasites could be discovered. I use the word "apparently" because this has not been done on a sufficiently large scale, nor have the observations been carried out for a sufficiently long

period, to entitle one to state definitely that sterilization is complete in all cases, but it certainly appears as if the destruction of the trypanosome is complete by the tartar emetic treatment. I may say that the treatment consisted of injecting 1½ to 2 grammes per day for five consecutive days.

That treatment has been so successful that the settlers in that area do not fear Nagana to any great extent. The treatment, or method of treatment has been handed over to the European settlers. They have been instructed how to carry out the intravenous inoculation, and in future they will do their own animals, and no veterinary assistance will be required, in the treatment of Nagana in the settled areas. One is, naturally, not absolutely satisfied that the treatment may not be improved in any way, and for this reason further experiments are still in progress. Furthermore, it has been decided to try Bayer 205 in the treatment of this disease. The German firm supplying this drug has asked permission to send one of their officers to the Union to carry out the treatment in the Nagana infected areas, and this permission has been readily granted. I expect that the gentleman in question will have arrived in the Union by now, so that very extensive experiments will be carried out with this drug. Now that the tsetse fly has been located in that area observations still continue in connection with the distribution of the fly. In connection with the treatment of trypanosomiasis with Bayer 205, I might just mention, that a few months ago I saw a report written by a member of the profession in the Dutch Indies on experiments with this drug in Surra. Apparently the results were not satisfactory, relapses being fairly common, that is to say, the blood of the treated animals was not completely sterilised. He also found that the drug was rather toxic for horses in large doses. I may mention, in this connection, it is supposed to be a non-toxic preparation.

Now, as regards the other disease, *viz.*, dourine, I may mention that it exists in various parts of South Africa, Griqualand, West Bechuanaland, in the western part of the Free State, and also in the Western Transvaal. Whether it has been spreading lately is difficult to say. Cases have been recognised in new areas, but the disease may have been there earlier unrecognised.

Dourine was first reported in the Union shortly before the war, and owing to war conditions no immediate investigations could be instituted, so that no definite diagnosis could be made or was made until 1918. As you are aware, it is an extremely difficult matter to demonstrate this trypanosome in the naturally infected animals. Microscopic examination of blood or other body fluids is practically always negative. The only way in which the disease can be diagnosed with certainty is by the application of a serological test, viz., the complement fixation test. It is also possible in some cases to isolate the organism by inoculation of blood of an infected animal into small animals, particularly dogs. A large number of experiments were carried out in this connection, and in all, except one case, we failed completely to transmit the disease. Only once have we been able to see the *Trypanosome equiperdum*, that is when blood was injected from a susceptible case into a pup, and even then, the parasites in the blood of the dog were extremely rare, so that this cannot be considered a very satisfactory method of diagnosis. The complement fixation test was first carried out by Canadian veterinarians and the diagnosis of dourine in the Union was confirmed by the Canadian authorities with serum forwarded from suspected cases.

In order to carry out this test it is necessary to have the trypanosome to work with. We had no strains of this trypanosome in the Union, so that the test could not be applied until a few months ago when we received strains of *Trypanosome equiperdum* from Europe. I am pleased to say, that the test is now being applied to suspected cases of this disease, and the results appear to be very satisfactory.

With regard to the control of dourine, I may say that, theoretically, at any rate, there are no difficulties. On infected farms all clinically affected animals should be slaughtered, and the sires castrated or else done away with. Quarantine regulations are also applied in these cases. At present it is difficult to say with any degree of certainty whether it is possible to eradicate the disease, as we do not yet know its distribution. Now that we have a method of diagnosis, I feel certain, that within a very short time, we shall be able to give correct information on the extent to which it exists in the Union.

Mr. E. Hutchins: As regards mechanical transmission of trypanosomiasis in Uganda: this does not appear to occur in our Eastern Province to anything like the same extent as it does in the Buganda and Western Province. In Teso, our most heavily stocked district I do not know of any case of trypanosomiasis having been recorded. West of the Nile, trypanosomiasis in cattle (tsetse fly free) areas has been found in almost every area. If some really effective means of control could have been brought into operation during past years, there is no doubt that planters would have employed ox transport to a much greater extent to move their produce, and also very largely reduced their labour by utilising oxen for the cultivation of their estates.

THE CHAIRMAN: We are inclined to think that the whole of Zululand is covered with tsetse. Certainly, at the time of my visit in 1919, tsetse was shewn to me by a District Commissioner as having been taken on a road which had been cut some years before, but the remarkable thing was the difficulty which everybody had to recognise the fly. It was the custom to throw various flies on a table, and it was very rare that the local people could pick out the tsetse. They did not know it, the natives did not know it, and had no name for it.

In connection with dourine diagnosis, while at Onderstepoort serum was sent to Canada from believed infected and from clean animals. In each case the authorities there effected a positive test only with those suspected.

Mr. W. KENNEDY: A suspected outbreak of dourine came under notice recently in this Colony, in a stud of racehorses. Serum was sent to Canada for test and the result was negative.

I should like to ask Mr. Power what quarantine restrictions are imposed in South Africa for trypanosomiasis.

Mr. W. M. POWER: Until quite recently no special restrictions have been imposed on movements of animals in Zululand. No ill-effects have occurred as a result of movements from the old infected centres.

Recently the people were of opinion that restrictions should be imposed. At present movements of animals are allowed on permit, and each application is considered on its merits.

I would like to hear something on the question of restriction of movement of cattle in such areas.

THE CHAIRMAN: It appears very clear from what you have said, that there is no danger in movement of cattle outside those areas.

Mr. W. KENNEDY: I may not have made myself quite clear regarding our system of control. When an outbreak occurs on a farm, the farm is placed in quarantine. If a veterinary officer is available the blood of all cattle on the farm is examined microscopically at intervals. Transport cattle apparently free from infection are permitted on the public roads.

Mr. U. F. RICHARDSON: The Chairman's observations seem to cover most of the discussion. The main point seems to be about mechanical transmission, which we believe occurs very commonly in some of our districts, probably depending upon the nature of the country. The general opinion seems to be, that the disease is mainly connected with tsetse and some research is required into a method of dealing with them.

RESOLUTIONS.

TRYPANOSOMIASIS—TSETSE BIONOMICS.

1. This Conference would emphasise the importance of trypanosomiasis throughout Africa and the large areas rendered unsuitable for stock by its prevalence.

It is of opinion that further research is required on the bionomics of tsetse flies and on methods of restricting and eradicating them.

2. This Conference urges, that as in some areas the so-called mechanical transmission by agency other than tsetse flies appears to be of great importance, further investigations are required.

A. SPECIFIC ANIMAL DISEASES.

(5) Horse sickness.

Dr. P. R. VILJOEN (Sub-Director of Veterinary Education and Research, Pretoria): At the outset I wish to make it quite clear that I did not offer to open this discussion. I have only agreed to do so because no other Delegate was prepared to undertake the task. My reason for not being anxious to introduce the subject is that I have not personally been engaged in experimental research in connection with this disease.

As you are aware, horse sickness has been known in South Africa for very many years, in fact, ever since Europeans first settled in the country. It has a well-recognised regional and seasonal distribution, that is to say, it occurs in certain very definite regions of the country and also at definite times of the year. In our country, cases of the disease can be expected any time during the summer months, but the disease is at its worst in February, March and perhaps in April. It generally stops completely after the first frost has fallen. Animals running day and night in the veld contract the disease most. When horses or mules are stabled at night cases of the disease occur more rarely. If insect-proof stables are used the animals are practically free from attacks of horse sickness.

The cause of the disease is, as you all know, an ultra visible virus. The virus is present in the blood and organs of the animals. It is very tenacious, and if kept in the laboratory will keep its toxic properties for a few years.

The method of infection, that is the method by which the infection is introduced into the animal, is not definitely known, but our observations extending over very long periods tend to show that it is almost certain that a blood-sucking insect is the transmitting agent. One can continue to speak on this part of the subject for perhaps a whole hour, but I do not intend to bring up the arguments for and against this contention. I need only mention that horse sickness and malaria usually go together. The virus of horse sickness remains in the recovered animal for a short period only. In exceptional cases the blood may be infective for as long a period as three months. The horse, therefore, cannot be considered as the natural reservoir of the disease, *i.e.*, after the animal recovers it becomes free of all infection after a certain period. We have every reason to believe, however, that virus reservoirs must exist somewhere. Now I have previously explained to you the remarkable proof we have in South Africa of the existence of such reservoirs. I mentioned to you that in the Free State we have a disease in cattle called Snotsiekte and that this disease is contracted from the black wildebeest. The farm that I am referring to in the Free State is owned by a wealthy man who keeps the wildebeest as a private hobby and these animals suffer no ill-effects. They remain perfectly healthy and normal, but if cattle are allowed to run in the same paddock and brought into fairly close contact with the wildebeest, then they contract the disease referred to. In the case of horse sickness I mentioned, there is almost certain to be a reservoir in which the infection is kept alive when no cases exist in horses. We in South Africa, unfortunately, do not yet know what particular animal we have to look to as a possible reservoir. We believe that it is possibly not an equine animal.

Now I do not propose to discuss all the other aspects of the horse sickness question, but will deal very shortly with the methods that can be adopted to control or suppress the development of the disease.

In the olden days the horse was a very important animal from an economical point of view. Nowadays, horse breeding in South Africa is not a very big business. You will no doubt know the reasons for this. Mechanical transport has made enormous progress in this country, so much so that it has taken the place of the horse to a very large extent. Moreover, the value of the horse to-day is not very great, and horse-breeding is not exactly a paying proposition. Besides that, as I mentioned earlier, we have certain areas in the Union where horse sickness does not occur at all, and horse-breeding can be carried on successfully in those areas without veterinary assistance in so far as this disease is concerned. So that the control of horse sickness from a breeding point of view does not concern us very much in these days. We, however, are looked to to assist farmers in bad horse sickness areas, that is, to find some means of keeping their horses free from horse sickness by immunising them in these areas. There are, as you will understand, two ways of dealing with this problem. The one is, to prevent the animals from becoming infected. This can be done in different ways. In the olden days, the Transvaal farmers used to trek during the horse sickness season from horse sickness infected veld to other veld situated on a higher level and in a part of the country, where the disease was absent. Nowadays that is not being done to any great extent. For the small farmer only possessing a few transport animals that have not been immunised, the method recommended is simply to make his stable as insect-proof as possible. I am sure Mr. Power will give you more details of this. The stables are usually smoked at night, the effect of this being to keep flying insects, such as mosquitoes, out of the stable, and as far as I am aware the method is successful. Another method that has given fairly good results, is the application of paraffin all over the body and particularly to those parts where the insects are most likely to inflict their bites. This, if carried out regularly, gives fairly good results. In my own experience in the German West African Campaign, horse sickness was found to be extremely prevalent in Upington and yet it was possible to save the better horses belonging to the staff by adopting this method. In this case, the Commanding Officer himself attended to the paraffining every night, and I must say the method described appeared to be quite successful. Now these are the methods that our farmers all know and make use of to a smaller or greater extent.

One other I may mention, and that is, the systematic dipping of the horses in horse sickness areas. We have carried out a great number of experiments in this direction and have used different substances in the dipping fluid, substances which may have a repellant action against mosquitoes and flying insects. Fish oil was one of the things that appeared to give fairly good results, but it had a scalding effect. Even at the present time we recommend regular dipping at weekly intervals, and we advise farmers to use the ordinary laboratory dip which contains paraffin as one of its constituents.

I shall now say a few words, gentlemen, in regard to the preventive inoculation or immunisation against the disease. In the immunisation of horses and mules against horse sickness one employs the so-called simultaneous method, that is the injection into the animal of serum and virus. The method now adopted for horses consists of three separate injections. First of all the horse gets a weak virus (the so-called Tzaneen Virus) which produces a fairly severe temperature reaction but seldom causes death. This preliminary reaction gives the horse a certain degree of immunity against the more deadly virus which is injected on the seventh day. Together with this second virus the horse gets a dose of serum to assist him in counteracting the effects of the virus injection. This is followed up three days later by another serum injection. You will see, therefore, that we give the horse a double immunity against the weaker "Tzaneen" and the stronger "O-Virus." Horses which pass successfully through this process possess a very strong degree of immunity against these two viruses. It is, however, found that when such horses are exposed to a natural infection of horse sickness, a certain percentage (roughly 30%) will contract the disease and 10% to 15% may die. This fact points to the root of all our trouble with the immunisation of horses. In practice, it is impossible to give the horses a polyvalent immunity which would protect him against all viruses encountered in the veld.

In the case of mules the process is much simpler. These animals get a simultaneous injection of "O-Virus" and serum. The method has been entirely satisfactory.

The losses from the inoculation are practically nil, and the deaths which result from horse sickness naturally contracted afterwards are also very small.

With the more susceptible horse, I am sorry to say, the position is entirely different. In this animal our investigations have received very serious set-backs. First of all, a few years ago infectious anæmia of horses came in as a complication of the horse sickness inoculation, *i.e.*, by the use of the virus and serum for immunising horses the virus of a different disease was incidentally injected into these animals and quite heavy losses were occasioned. After considerable experimental work we were able to overcome this difficulty. It was found that by keeping the immune serum for a long period the virus of pernicious anæmia would die off, whereas the serum itself maintained its good qualities. After this we again proceeded merrily with the inoculation of horses thinking that our troubles were over, but another and much more serious set-back was encountered some time ago. In immunised horses it was found that a very serious and fatal disease developed. This disease was called by the farmers, who first observed it, "mad staggers." The affected animals stagger about, fall down and die after becoming comatose. This is a very good name for the disease, as it expresses very well what one may expect. Our statistics show that this disease is, in many cases, connected with the inoculation against horse sickness. Comparatively few cases have been observed in animals which have not been inoculated, and in animals, which have recovered from horse sickness, they also are not so common.

During this last season horse sickness has been very bad in the Union and a large number of animals have been inoculated at the laboratories. Of these, shortly before my departure, quite a number developed " staggers."

We know practically nothing about this disease, how it is caused and so on; all these factors remain obscure. Needless to say, my illustrious Chief, Sir Arnold Theiler, is still taking a keen personal interest in the matter, and is carrying out extensive experiments, and one hopes that his efforts will be crowned with success, not only because of the loss to the farmer, but also from a purely scientific point of view.

Apart from these complications, our horse sickness inoculations have been quite successful. The losses arising from the inoculation itself have only amounted to about 5% taken all the year round, and in some cases only 1%. In practice the immunity produced by this method has also shewn itself to be satisfactory. During this last season, which I have mentioned as having been an extremely bad one, only about 10% deaths have occurred. From this you will see that if it had not been for these complications, the method could be considered satisfactory.

I realise, that what I have said gives you rather a sketchy idea of horse sickness, but I trust that any further points you may desire information on will be brought forward during the discussion. It is an enormous subject to deal with in the short time at my disposal and one has difficulty in selecting the points that will interest you most.

Investigations are necessary to clear up the question of transmission, to find a possible reservoir for the virus, and to improve the methods of immunisation.

THE CHAIRMAN: There is no doubt that horse sickness occurs in many parts of this country, but it has never been diagnosed outside of Africa. We know, or have reason to believe, that it has not occurred in any other continent. During the construction of the Uganda Railway horses and mules died of horse sickness, there therefore, occurred a pre-existing reservoir.

Blood has been collected from domestic animals, wild animals, large and small mammals and birds of all descriptions, and this blood has been injected into horses without result. The nearest conclusion that we can come to, seems to lie in the fact, that some affinity with the goat and the dog exists. There are several points at issue between these animals and the horse which require further consideration.

Transmission: Every field observation made up to the present goes to prove, that the disease is seasonal, and chiefly with the rains, and that warm weather and warm country are important factors.

From the first experiments conducted, it was indicated that the best preventive measures to be adopted, were those of burning smoky fires in the immediate neighbourhood of the stables during the night, and that the erection of mosquito proof buildings both tended to make the horse less liable to contraction of the disease. But we remain entirely ignorant as to whether the nocturnal insect, if such it be, is a mosquito or a moth, or another species of biting fly.

I was certainly impressed, whilst at Onderstepoort, with the enormous number of well-controlled scientific experiments, with practically every species of mosquito occurring in South Africa, which were conducted to obtain a further knowledge of the transmission of the disease. But they were all negative, and the more negative results one gets, the more one wonders whether the mosquito is, after all, the real factor of the disease. At one period, as I well know, Sir Arnold Theiler had a most elaborate mosquito-proof house together with all the ideal conditions for breeding mosquitoes and using them for experimental purposes, and special stables for both healthy and sick horses. The number of experiments conducted in the research of this disease have indeed been legion at Onderstepoort. Yet, the results so far have been negative. Suspicions were again cast upon certain moths which love to flutter round the horse's eyes, and at one period of the war eye fringes were employed for horses, and they were well reported on.

The matter to me is still open, and we must not forget that the farming community of South Africa feel that there is something to do with the grass and dew in its relation to the disease. Experiments in connection with the muzzling of horses were also made at Onderstepoort, but no light on the matter has as yet been shed.

Horse sickness has occurred in this country on several farms, and has been clinically and experimentally confirmed. Blood from those cases has been shewn to contain different strains. As an example of strains, reference may be made to those used for immunisation purposes in South Africa; one strain used practically never kills a horse, though the symptoms manifested by the inoculated animals are those typical of horse sickness. But, it was proved that in recovered cases no absolute immunity was conferred to a second strain. The action of the second strain is very virulent, the incubation is very short and unless you are following the temperatures closely and also the condition of the animal, death appears to occur very suddenly. It is extremely virulent. The occasional horse which recovers, if tested, will still develop the symptoms of horse sickness with the first mentioned strain. This is a demonstration of two very divergent strains and we have had similar experiences in this country. As Dr. Viljoen has indicated the difficulties of working with horse sickness are very considerable and costly; one must have a large number of horses and purchases of these animals for experimental purposes can only be afforded by wealthy countries. If small animals could be found, which are susceptible to the disease, and suitable for working on, there is no doubt that more rapid progress would be reported.

However, the latest results of the inoculation in South Africa, quoted as 5% losses and 10% breakdowns, show that considerable progress has been made during the past four years, because in 1910 the average was 20% of losses and breakdowns.

I recollect one interesting case which occurred in Swaziland. A farmer there had six horses immunised, and shortly after immunisation four of the horses were sent down-country to an area rife with horse sickness, and did well, being alive four years afterwards. The remaining two horses were sent down about three years after immunisation, they were both dead in three months. It appears, therefore, that there is a need for maintaining immunity provided by the laboratories, either by exposure to natural infection, or conceivably by inoculation with a small dose of virulent blood.

Undoubtedly there is an affinity between horse sickness and malaria, and it would be of great value to collaborate with medical men in order to compare the incidence of these two diseases in various places. But I think you are well aware of the fact, that horse sickness occurs in some places, and at some times, where people certainly have every opportunity of contracting malaria and do not, and *vice versa*.

With the other precautions indicated by Dr. Viljoen we are all familiar, but he does raise one point in connection with the South-west Campaign, and the results that followed the use of a paraffin brush. At Upington, there were several reports all of which seemed to indicate that cures had been found, and one individual was so convinced that his was a genuine cure, that he paid all expenses and costs in connection with experiments connected with his cure at Pretoria. However, it was of no avail, because the disease with which he was faced at Pretoria, was not the same as that which he had cured at Upington.

With regard to dipping in fish oil, I remember in some cases where it was used it was responsible for very severe scalding of the animals; this may, however, have been due to the fact that it was applied too strongly and further experiments are required.

Acute liver atrophy is undoubtedly, at the present time, one of the most important factors in connection with horse sickness immunisation, and I suggest that enquiry be instituted in other countries to observe the effect of Pretoria serum.

Mr. H. E. Hornby: When I was in charge of a veterinary hospital in German East Africa during the war, one of the chief problems there was horse sickness. I tried curative measures without success, and it appears that we are still without a remedy. That being so, may I be permitted to suggest that a trial be given to sodium thiosulphate? My reasons are these: Deaths from horse sickness are I think due largely to œdema of the lungs, which indicates an increased permeability of blood vessel walls. An œdema of the lungs commonly met with is in the anaphylactoid shock which often follows the transfusion of a large volume of blood from one bovine to another. Formerly hyper-immunisation against rinderpest was effected by me by this method, but as has been the case with others I had to abandon it owing to the grave losses from such shock. Before doing so, however, I tried the effect of various drugs which are stated to lessen the permeability of cell membranes. I tried calcium chloride, but did not find it of any value. Then I used sodium thiosulphate, and of the series of 60 animals which received the sodium thiosulphate at the same time as they received the transfusion of blood, a very much smaller percentage died than the 8% which was the mortality among the controls. My point is that as we are without knowledge of any specifically valuable drug, I suggest that if anyone has a case of horse sickness he might try the effect of the administration of large doses of sodium thiosulphate? I should like to ask if Dr. Viljoen thinks that the administration of Stockholm tar may, by the excretion of its products through the skin, protect the animal from biting insects which may carry the disease.

Finally, in connection with the co-existence of malaria and horse sickness, I remember that in Dar-es-Salaam we were without any cases of horse-sickness for several months. Then the disease suddenly set in, at the same time the incidence of locally contracted malaria rose markedly.

Mr. F. J. McCall: During the war I had the opportunity of observing large numbers of animals suffering from horse sickness. All manner of expedients were attempted such as rubbing with paraffin rags, burning smudge fires and the using of nosebags at nights. Experiments were also made with every drug that ingenuity could suggest, yet it seemed that all our efforts did not have the slightest effect in ameliorating the condition or influencing the death rate. I have seen cases of horse sickness at 9,000 feet and at sea-level. Personally I am unwilling to advance any hypothesis on the subject, but nevertheless incline to the belief that early stabling, the use of smoke fires, mosquito netting and paraffin brushing are all indicated. Many owners temperature the animal morning and evening and in the event of a high temperature being recorded, keep the fevered animal as quiet as possible in a dark, cool loose-box, and only feed on laxative diet. It is claimed that this precaution is most effective in reducing the mortality.

Mr. W. Kennedy: Last season was a very bad one for horse sickness in this country, and Dr. Viljoen remarked that he had a similar experience in South Africa. We lost 103 horses in June and July and 92 of these animals died in the Nairobi and Nakuru districts.

The only steps we have taken to deal with the disease are in the nature of preventive measures. Horse owners are advised to stable their animals in mosquito-proof stables, and to keep smudge fires going at night. Dr. Viljoen referred to the apparent association between horse sickness and malaria in South Africa. Such an association could only be found to exist in a few areas in this Colony. Outbreaks of horse sickness have occurred at an altitude of about 9,000 feet and there is certainly no malaria in these particular districts.

During the war some immunised horses were sent up from South Africa, and we endeavoured to ascertain if any of these animals died of horse sickness. Unfortunately, wherever these horses were employed the tsetse fly abounded, and I should think that about 90% of the horses which died succumbed to trypanosomiasis. Eye fringes were used, and at times paraffin dressings were applied, mainly in an endeavour to ward off attacks of tsetse flies. Unfortunately the paraffin did not seem to adversely affect the tsetse fly and the resulting mortality from trypanosomiasis obscured any good results that might have been obtained from some of the measures adopted against horse sickness. Treatment with drugs was attempted in a few instances, but no satisfactory results were obtained.

I should be glad if Dr. Viljoen would give us some particulars as to the percentage of immunised horses which develop acute liver atrophy and the period of incubation of this disease.

I should also be glad to know what dose of sodium thiosulphate is recommended by Mr. Hornby in the treatment of horse sickness.

Mr. H. E. Hornby: As a preventive of shock I used to inject one, two or even three grammes in aqueous solution intravenously. I am of the opinion, however, that one can give much larger doses.

Captain R. H. Knowles, R.A.V.C. There are one or two points of interest with regard to horse sickness in the Sudan. Horse sickness is fairly extensively met with in the Sudan, but chiefly in the south, but we do get it regularly as far north as Khartoum. There was one visitation of the disease in 1920, at Port Sudan, which is much further north than Khartoum. They have not had it since, and never had it before then. There were only ten horses there. Suddenly horse sickness appeared, and eight of the horses died. There is no malaria there.

Another point with regard to its distribution; at Wad Medani, a place on the Blue Nile, which is the headquarters of the Sudan Plantation Syndicate horse sickness is on the increase. This year they have lost 19 out of 40 polo ponies. There is a large amount of irrigation there and it would seem that this increase of horse sickness is accounted for by the increase of irrigation. Another point of interest about horse sickness at Wad Medani is that cases of the disease have occurred up to February of this year. Our usual season here is from July to November. One invariably stops using smoke fires in December, and one regards oneself as fairly secure against this disease after that month. This year, however, the disease did not stop in November, but carried on until February. I do not see why the disease should stop in December in the Sudan, because even then at night time the temperature rarely falls below 60 degrees.

Another point of interest is the susceptibility of the different breeds of horses. In the Sudan it is well known that the Arabs are more susceptible than the country breds. The Egyptian Army in the Sudan formerly used Arabs, however, the losses were so high that Arabs are no longer employed in the Egyptian Army except in special cases.

Mr. W. M. Power: I cannot add anything very useful to what has already been said. There is little horse-breeding in Natal now. People found that horse-breeding did not pay, and so have gone in more for cattle and sheep. As Dr. Viljoen remarks, horse-breeding is generally carried out in areas which are free from horse sickness. I may say that we have had occasionally serious outbreaks amongst horses, even in areas considered safe, and large troops of horses have lost over 50%.

It is certainly clear that treatment, both preventive or curative, is of great importance to people, especially to those who have to keep horses for working in towns and cities, etc., in addition to where horses are kept for racing, sport, etc.

Dr. Viljoen and other speakers refer to the smoking of stables. In Natal this is carried out largely, and in some of the towns smoking is carried out in a very systematic manner. Stoves are arranged with pipes running all over the stables, they simply burn stable manure. The fires are lighted at four o'clock in the afternoon and are kept alight all night. Everybody seems to be satisfied that this is a sound precaution, and I personally know that these places lose very few horses.

Re Paraffin: When people have to travel with horses they often carry paraffin and a brush. The brush is so constructed that the paraffin exudes through the bristles on application to the horse, so that all that is necessary is to brush the horse over with it.

Dipping has never become popular as a precautionary measure against horse sickness. Mares and foals do not stand dipping well, and as a rule where horses are bred in any numbers is high veld usually free from the disease.

Re horses immunised in Pretoria: We have had experience in Natal, where such horses were turned out and they were allowed to run out night and day, very few of these died. There is no doubt that in this case a very satisfactory immunity was produced.

Mr. F. J. McCall: Has anyone any knowledge of the occurrence of horse sickness in the donkey?

Mr. J. A. Griffiths: In the districts of Nyassaland in which horses are known to suffer severely from horse sickness, this disease has not been known to infect donkeys.

The Chairman: Before asking Dr. Viljoen to wind up this discussion, I am going to make a suggestion to the Conference. As this is a Pan-African Conference, I suggest that when he returns to South Africa, he asks the authorities at Onderstepoort to undertake a systematic enquiry in connection with this disease, and that they form themselves into a Pan-African Board of Enquiry into the subject. South Africa is already in possession of most important knowledge of the disease in connection with rainfall, locations, etc. It seems to me the more parochial we become, then certainly the less rapidly are we going to come to any conclusion, not only as to the epizootology of horse sickness, but also in connection with acute liver atrophy. It is quite possible that some other country than the Union might be of great assistance to them. It appears that liver atrophy does not always occur, and I suggest, therefore, that Dr. Viljoen approaches Sir Arnold Theiler to institute a series of experiments with their serum and virus in other localities. For instance, Nairobi would possibly be a good centre to conduct these experiments to ascertain if acute liver atrophy can be developed here.

Dr. P. R. Viljoen: I was rather reluctant, as you know, to introduce this important subject, but I think the discussion which has ensued, consequent on my short introductory remarks has well repaid me for opening the discussion. The experience of the different Delegates from all over Africa has been extremely interesting.

I don't think that it is necessary to say very much in conclusion. It is a difficult subject on which to pass resolutions, and I think the one suggested by the Chairman is perhaps the only one that need be put up.

I am quite sure the Union Authorities will do all they can to meet the requirements of other countries. It is quite unnecessary for me to say that you can rest assured that every effort will be made by Sir Arnold Theiler to find a solution for these different obscure points. I feel quite justified to say this, because Sir Arnold Theiler has practically made horse sickness his life study, and to-day he has the same interest in this problem that he had many years ago, and which he has kept all these years.

With regard to the large number of points raised this afternoon, I may mention that the methods of preventative treatment that I mentioned were not really brought forward because they have been proved to be effective. They are merely methods which are being tried by people in the Union, because there are no better known ones. From practical experience it would seem that the smoking of stables has given the best results. My remarks covering the application of paraffin were only to show that possibly in some cases it might be of assistance. The experience, which I related as having occurred at Upington, was only to show that some good results from the attempts at prevention. The death rate from horse sickness in this outbreak was enormous, so much so that it was decided to get away from Upington area as quickly as possible. I am quite sure that if we had stayed there for another month the Mounted Brigade would not have been able to move off. It may have been pure coincidence that a number of staff horses (60) escaped infection, but it is of sufficient importance to be brought forward as an example of what may be attempted.

I purposely left out the drug treatment in cases of this disease, because we have had very little success with it. In a place like Onderstepoort, where most extensive investigations are proceeding with this disease almost daily and continuously, most drugs have had some consideration paid to them. Only recently I remember Sir Arnold Theiler tried a fresh number of preparations. I believe that Brilliant Green and other similar preparations were included in the ones he tried. The application of Stockholm Tar is a very old method of attempting to prevent infection of horse sickness; it is a very common thing for our farmers to smear Stockholm Tar around the nostrils and mouth of the horses at night. Some even go as far as to use muzzles which are smeared on the inside with some of this preparation. It is very difficult to say whether any beneficial effects have been derived from this method, because there are no reliable statistics available.

With regard to the question raised by Mr. Kennedy concerning, the development of staggers, I may mention that the disease usually occurs several months after immunisation of the animals against horse sickness. I do not remember just now the shortest or the longest period after immunisation that symptoms of the disease occurred, but one can safely say several months (perhaps three or more). It is quite impossible to give the percentage of animals which have developed this condition. Horses are immunised at the laboratory, and passed out to different farmers all over the country, and it is not always that farmers report deaths. No true statistics are available and I am afraid I cannot say anything definitely on the percentage of animals that contract the disease.

Lastly, I can only say, I personally have never seen a donkey suffering from horse sickness naturally contracted.

As mentioned at the beginning, I do not consider it necessary to formulate any resolution in connection with this disease; if the meeting desires it to be done it can be considered later.

RESOLUTION.

HORSE SICKNESS.

This Conference urges that a Pan-African enquiry into horse sickness be instituted, such enquiry to include its incidence, prevalence and virulence in nature, and its association with mosquitoes and other insects.

A. SPECIFIC ANIMAL DISEASES.

(6) Anthrax.

Dr. P. R. VILJOEN (Sub-Director of Veterinary Education and Research, Pretoria): Anthrax, as you are aware, is a disease that occurs all over the world, and is, therefore, of enormous importance. Since I have been doing some research work in the Union in connection with this disease during the last few years, I am very glad of the opportunity to lay certain observations before this Conference.

Anthrax, in South Africa, is of great economic importance. It is at the present time, undoubtedly the most serious disease we have to deal with. In his last annual Report the Principal Veterinary Officer for the Union stated "that Anthrax was responsible for more losses among farm stock than the total losses from all other contagious diseases." Recently a great many new outbreaks of anthrax have been recorded and confirmed in the Union. It is not quite certain that some of these had not existed for some time, for the simple reason that recently farmers have been making more use of microscopic diagnosis to assist them. They have been sending blood smears from animals more regularly and more often to the laboratories, with the result that anthrax has been diagnosed in many places where it was unknown before, or where it had not been diagnosed before. This is, in my own opinion, one of the reasons why the disease appears to be so widespread to-day, although undoubtedly it has been spreading during recent years.

I propose spending most of my time in dealing with the control and eradication of the disease, but before doing so, it is absolutely necessary that certain points in connection with the causal organism, its mode of life, its method of spread, etc., shall be considered.

With these points I will deal only very briefly. First of all, the causal organism as you know is a strict aerobe, being able to multiply only when having access to oxygen. The other point to consider is whether the organism under our South African conditions is a strict obligatory parasite, that is whether the organism can only multiply in the animal body or whether it can exist in a saprophytic way, that is, whether multiplication can take place outside the animal body, in the soil, etc. You are no doubt aware that in Europe the general opinion is that the organism is an obligatory parasite, that multiplication takes place only in the animal body. There are many points in favour of this view. One need only mention one, namely that in England, at any rate, the disease is under very strict control and sources of infection can nearly always be traced to outside countries, the infection coming into England in foodstuffs, hides, skins, etc. As you will see later, when we discuss the question of control or eradication of the disease, this point is of the most vital importance.

A most important point in connection with the anthrax organism, that must be mentioned here, is sporulation. As you are aware, sporulation generally speaking, takes place only under unfavourable conditions of growth, temperature, food requirements, etc., and in the case of anthrax only when the organism has free access to oxygen. In the animal body no sporulation can take place simply because the food requirements in the blood are the best obtainable, and again after the death of the animal sporulation cannot take place because the oxygen in the blood and tissues has been exhausted. It need only be mentioned here that unless the carcase is opened, cut into in any way, so as to allow the entrance of air or oxygen into the body, the anthrax bacilli must die within a very short period. As regards the method of spread of the infection one can safely say that practically the only serious source of infection is the infected carcase. As I mentioned before,

if such a carcase is left unopened and undisturbed the danger will not be so great, but farmers and particularly natives, out of ignorance or not suspecting the animals to have died of anthrax, skin them, and expose the hides or skins for sale. When an anthrax carcase is cut into, every drop of blood that escapes contains millions of organisms which soon after their escape from the animal body commence to sporulate, are spread in the soil of the neighbourhood, and carried further away by water, rains, etc., or even in the dust. If such a carcase is left on the veld, dogs or wild carnivora will probably pull it to pieces, and carry the meat or bones about the countryside, thus distributing or spreading the infection further. The disease is not spread to any extent by the sick animal, for the simple reason that not many spores are usually contained in its droppings, and there is no other way in which the organisms can leave the body of the sick animal. It is only in the strictly intestinal form of the disease that a fairly large number of organisms escape by way of the intestinal tract. The disease can be spread from one farm to another, by the movement of sick animals which may die on a clean farm, and thus infect the latter. By the transportation of hides and skins of anthrax carcases the disease can be spread far and wide.

As you know, a great deal of attention has been paid to this particular question in Europe during the last year or so, and the Labour Committee of the League of Nations have taken this question up with a view to coming to some understanding between the different nations regarding the handling of hides and skins from countries where the disease exists.

We, in the Union, realize that the disease has got to be tackled very seriously, even if only from the point of view of export of hides, skins and wool. Now, I must just mention to you the animals, which are principally affected by the disease in the Union, and also the methods of infection of the different animals. The disease occurs very commonly amongst cattle, sheep and goats, and in these animals infection usually or nearly always takes place by the ingestion of infected material. The disease in these animals is nearly always of a septicæmic form. Horses and donkeys also suffer to a large extent from anthrax, and in them, the disease is particularly bad in certain parts of the Union. In the drier parts of South Africa, particularly in Griqualand West, or Western Free State, and the Western Transvaal, the horse fly (Hippobosca) is extremely widespread. In the early summer months these flies hover round horses like swarms of bees, forming huge clusters on certain parts of the animals. There remains very little doubt in my mind that these flies are the main carriers of the disease in horses in those areas. Once cases of anthrax appear, flies sucking the blood of infected animals, particularly towards the end of the disease, become infected with anthrax organisms. These flies leave the dead body within half an hour or so of death, and swarm on to healthy horses in the neighbourhood. They settle particularly under the abdomen, on the sternum, in the inguinal region, on the sheath of the males, and udder of the female, and it is in these parts that anthrax swellings first manifest themselves. Where these flies settle, if we observe the case carefully, small swellings will start developing and these gradually get bigger and bigger, at the same time being covered with the flies. I should mention here, so as to make the case clearer, that the horses in these parts, nearly always live for three or four days before death supervenes. During the last year we have tried to clear up this matter, but unfortunately we did not get final results, because the disease disappeared from the farm before the experiments were finished. We were able to prove, however, that the flies were infected when picked off the sick and dead horses, so that there is not much doubt that they can transmit the disease. When discussing vaccination against the disease later on, I hope to come back to the question of fly transmission, because it is of great importance in horses.

Regarding the control of the disease, it is hardly necessary to mention that there are two main methods that can be adopted, the first, a very important one, is the proper disposal of all carcases of animals which have died or suspected to have died from anthrax. I have already mentioned how the infection can be spread when infected carcases are carelessly handled, and to show you that this method is of enormous value in controlling or even exterminating the disease; I shall give you an example. A few years ago, on the experimental station in Vryburg, anthrax appeared suddenly amongst our experimental cattle. Quite a number of deaths took place within a very short time. The carcases were first of all burnt as completely as possible on the spot where the animals died, and the remains of this burning process were then buried six feet deep on the same spot. Furthermore, a fence was erected round the place of burial, so that no animals could afterwards graze over that part. It is now a good few years ago that this happened, and to this day no further cases have occurred on that farm. I may say that at the same time, the animals were not inoculated against anthrax, because it would have interfered with our other experiments, so that the animals on the farm remained susceptible to the disease. A few months ago Sir Arnold Theiler had the graves dug up with the object of trying to isolate the organisms from pieces of bone, etc., that remained, but attempts at isolation failed completely in every instance.

Quarantine measures can also be adopted but are of very little value in this disease. While there are sick animals on the farm you will realise, it is advisable not to move them from the farm, because they might die on the road or on other farms and in that way spread the disease.

I shall now go on to the most important method of dealing with anthrax, and that is preventive inoculation against the disease. Recently we have been trying three methods of preventive inoculation. First, the Pasteur method which has been in existence for very many years, second, sero-vaccine which has been in use in Germany and to some extent in the United States for some time, and thirdly, the so-called Spore vaccine. Dealing with Pasteur vaccine—first, I need not say very much, excepting that we have found this method of very little value in the Union and have completely discarded it. The reason for this is that if a vaccine is prepared according to the Pasteur method, it will contain vegetative forms or bacilli and not spores. As a matter of fact, it is difficult to prevent sporulation during the manufacture of anthrax vaccine, with the result that many of the Pasteur vaccines contain some spores, and the good results which are sometimes reported from the use of these vaccines, are entirely due to the accidental presence of these spores. If perfectly fresh vaccine could always be used, that is, vaccine not more than two or three weeks old, then the Pasteur vaccine is perfectly good, but it is not a practical proposition to issue vaccines that will not keep for more than two or three weeks. I need only mention that the use of the Pasteur vaccine has proved disastrous in certain cases in South Africa. Only recently, last December, a very severe outbreak of anthrax occurred in horses in the Kimberley district. These horses had previously been vaccinated with vaccine obtained from the Pasteur Institute. Apparently they had no, or hardly any, immunity against the disease and as soon as cases began to occur and the horse flies in those parts became infected then the disease spread almost like wildfire. Losses were enormous, 50% or more of horses on some farms dying from the disease. I may say that infection was so widespread that even wild game contracted and died from anthrax. We have isolated the organism from dead springbok found on the veld. As soon as farmers realised that their animals had no immunity against anthrax, the assistance of the Union Veterinary Authorities was called in and the Government vaccine, that is, our spore vaccine, was used immediately. After vaccination deaths continued or even increased during the first fortnight, as one would expect. The spore vaccine is a fairly strong one, although one can make it any strength one likes, but we consider it necessary to have a fairly strong vaccine to produce a good immunity. When such a vaccine is injected into animals which are already in the incubation period of the disease, the so-called negative phase is set up, and they are often more susceptible instead of possessing immunity, and it is during this period that the losses are great in vaccinated animals. People without a great deal of knowledge or experience of vaccines and immunity, very often jump to the conclusion that the increased mortality after vaccination is due to the vaccine actually killing animals. Strictly speaking, it is so, but it is only because the animals are already infected. I merely mentioned this outbreak in the Kimberley district, to illustrate the failure of the Pasteur vaccine in some cases.

Now dealing with the sero vaccine, I may mention that this is a simultaneous method of inoculation, both vaccine and serum being injected into the animal at the same time. The idea is that the serum will give immediate protection, that is, produce a passive immunity, which is then followed by the active immunity set up by the vaccine part. The idea is a very good one on farms where the disease is actually raging. Immediate protection is required and theoretically should be obtained from this method. We have given this method a trial but so far have not had any great success. The immunity produced was found not to be as good as that obtained from the use of the ordinary spore vaccine. I may mention, however, that we have not discarded this method altogether and that further experiments are contemplated with the object of improving the method itself and to find the correct combination of vaccine and serum.

I shall now refer very briefly to the spore vaccine which is being made and used at Onderstepoort Laboratories. The spore method of preparing anthrax vaccine is a very old one and some years ago was used fairly extensively in Russia. At the present time, it is being used extensively in Australia and even in the United States of America. The method of preparation and the principles underlying it are briefly as follows: The first essential step is to find a suitable strain from which to make the vaccine. We usually try to obtain the most virulent strains in the country and then to attenuate the organisms for vaccine preparation. I am not going to waste your time by going into details of the methods of attenuating anthrax organisms. It will suffice if I mention that attenuation is done by heat; when the organisms are grown at an unfavourable temperature between 42 and 43 degrees Centigrade, we know that sporulation will not take place. I must emphasise that one must have an absolutely safe incubator, one that can be regulated to remain constant at 42.5 degrees Centigrade, otherwise it it useless. At this temperature the cultures of the organisms are grown for different periods 10, 20, 30 and 40 days, etc. After these intervals some cultures are taken out and sub-cultures are made, and put aside for testing of virulency

later. Before the virulency test on the different attenuations is carried out, single organisms are selected, because the organisms in the culture may amongst themselves vary in the degree of attenuation they have undergone. Provided one has got a suitable strain, and I may say a good deal of luck enters the discovery of a good strain, the further steps in the method of preparation are simple. In the Pasteur method the organisms are grown in a liquid medium, the idea being to get vegetative forms only. In this method one requires spores only. Now, anthrax spores are formed most rapidly and abundantly on the surface of a solid medium where the organisms are exposed to oxygen. We employ the so-called Fernbach flasks, containing solid agar. The optimum time of incubation for sporulation is not yet settled, but we are at the present moment engaged in work in this direction. As you will realise it is simply a question of getting as many spores as one can. The growth on the surface of the medium is washed off with saline, and 60% glycerine is added to preserve the vaccine and to prevent other organisms growing. Having got a suspension of spores, it is necessary to determine the dose of the vaccine, and for this purpose inoculations with varying doses of the crude material is made into a number of small laboratory animals and sheep. The highest dose we use is 20 c.c. and the lowest about one 10,000th part of a c.c. The high dose is required to show that the vaccine is not fatal to animals; the smaller doses are required to find the smallest amount of vaccine that will produce immunity. Usually the crude material has to be diluted from 50 to 100 times with further glycerine saline solution for the vaccine that is to be used in practice. The animals that have been inoculated to determine the dose of the vaccine are tested for their immunity, and no vaccine is used unless immunity is strong enough to protect against at least 1,000 minimum lethal doses of virulent anthrax. This briefly is the method adopted. I would not have wasted your time by going into such details but Mr. Walker asked me to supply this information.

The anthrax vaccine so prepared and at present issued from the Onderstepoort Laboratories gives excellent results in cattle and sheep, the immunity lasting for at least one year. Breakdowns of immunity are practically unknown. In horses, the vaccine is not quite so satisfactory for the reason that swellings sometimes are produced at the site of inoculation, and when large, these may prove fatal, although this rarely happens. When horses are in rather poor condition, and they can get their food only by grazing on the veld, the danger is greater, because by the position the animal assumes when grazing the oedematous swelling has a tendency to extend to the throat and head, and the danger of suffocation in such cases has to be considered.

In goats, the ordinary single vaccine is dangerous, the same as is the case with the Australian vaccine, which has been tried extensively. With the use of our ordinary spore vaccine from 10% to 20% of goats can be expected to die. With the Australian vaccine the mortality is 20% to 30%. The reason for this mortality is that the ordinary common goat in South Africa is very susceptible to anthrax infection and apparently is a difficult animal to immunise against the disease. I can state definitely that in our pamphlets of instructions, farmers and others are warned not to use this vaccine on Boer goats. I mention this because our friend from Portuguese East Africa has used the vaccine on goats and has suffered heavy losses. To overcome the difficulty a double spore vaccine has been prepared and the results, up to date, are fairly satisfactory. In these cases a mild strain is used for the first injection followed by the ordinary single vaccine a fortnight later, the first injection giving sufficient immunity to protect against the second. This same vaccine I may say is recommended for use on clean farms, particularly in horses that are likely to be very susceptible.

The next point I wish to refer to is the difference in susceptibility among animals in different parts of the country. We have had experience to show that horses and cattle in some parts of South Africa appear to be very much more susceptible than in other parts. The reason for this is, that on some farms some degree of immunity is present, whereas on the others where the animals are so highly susceptible, they had never been exposed to anthrax infection. In this connection it is necessary to explain that I hold the view personally that it is possible for animals running free on the veld to pick up small numbers of anthrax spores, so few that no visible symptoms of disease are set up in these animals and that, as a result, some immunity is developed. Our vaccine is being used right throughout the southern part of Africa, and it now and again happens that the same batch of vaccine may cause mortality on one particular farm. I am referring particularly to horses. The only explanation, as I said before, that can be offered in these cases is that the animals in question were extraordinarily susceptible to any form of anthrax infection. Such cases, however, are only rare, but they can prove serious because the owners of animals are likely to make a great deal of fuss. In South Africa it is considered necessary, for the reasons stated, to make different strengths of anthrax vaccine. Even at the present time we have a fair idea of the different forms of severity of anthrax existing in different parts of the country and we hope, that in the near future, our knowledge of the distribution and the virulency of anthrax in different parts of the country will be so extensive that when vaccine is ordered from any town in the country we shall know exactly

what particular strength to supply. In that way we hope to exclude all accidental deaths from vaccination. Since we know that there are strains of anthrax, in the same way as there are different strains of horse sickness or other diseases, there is no need to bring up arguments in favour of having different strengths of vaccine to protect against these different strains of the disease. In these fly areas that were mentioned, it is considered necessary to inoculate all animals annually at the beginning or rather in the late winter months, before the flies become numerous. The idea is to get immunity established in the horses, to prevent all deaths, and so prevent the flies from getting infected with the disease. If infection of the flies can be prevented altogether, then there is no danger of an epizootic form of anthrax occurring on these farms.

As regards the control and eradication of the disease; I can only say that until inoculation of animals on infected farms is made compulsory, cases of the disease will crop up and the infection will be kept alive on that farm. I may say that general compulsory inoculation against this disease is now being considered by the Union Government. Before such drastic steps can be taken, we must have absolutely reliable vaccines. One cannot compel a farmer to inoculate his animals if there is the slightest chance of the vaccine killing even a small percentage of his animals. I need hardly say that the employment of different strains of vaccine will be even more necessary in the event of compulsory vaccination being decided upon. I have not the slightest hesitation in saying if this method of dealing with the disease were adopted, vaccination would have to be carried out free for the farmer.

In the matter of eradication, I need hardly emphasise again the importance of the proper disposal of infected carcases. That is a question that you all very clearly understand and know the importance of. I mentioned to you before, that in this country we are not by any means certain whether the anthrax organism is a strict obligatory parasite.

If the disease is to be eradicated completely from the country, we must naturally know what the habits of the organisms are outside the body. Can they multiply outside the body? We don't know. How long can they live in the soil or water or anywhere else? That we do not know. Old text books will tell you that it is possible for the organisms to remain alive for 20 to 30 years and if that were true, the chances of complete eradication are rather remote, but I do not think we should accept a statement like that, which has not been proved in any way. Within the near future it is our intention to try and settle this very important point. It seems to me quite feasible that the organism may not live so very long. We have no idea yet what goes on in the soil. What other organisms there are and whether possibly Protozoa may attack and digest them. You will realise, that it is quite impossible to express an opinion on the possibility of complete eradication, when these points in the biology of the organism are not known.

Further research is also required in the matter of disinfection of hides and skins. You know that hides and skins which are exported from South Africa will probably have to be submitted to disinfection, and as far as one knows the present method of disinfection is not quite satisfactory. We will therefore have to face this question in South Africa and prepare ourselves for a possible order of this sort and try and find the best methods of disinfection. Before I left Pretoria, we already made a start in this work by the collection of infected samples of hides, etc., for testing disinfectants on. Previous tests with disinfecting materials have not been entirely satisfactory. I am not going into details of the methods by which disinfectants have been standardised, but I consider it absolutely essential, that we should use the naturally infected hides for the purpose, and by cultivation and other methods of isolation, afterwards find out whether all the organisms have been killed in the hide that has been placed in the disinfectant. I consider it quite an important matter for discussion by this Conference.

Further research is proceeding in the improvement of our vaccine, and I have indicated in what direction improvements are necessary. I think that is all I need say in the way of introducing this important subject for discussion by this Conference.

Major Paul Tissie: Anthrax occurs all over Madagascar; it affects zebus, imported cattle, horses, grade and imported sheep, and ostriches. The native sheep do not contract the disease naturally.

I.—Bovines. Anthrax outbreaks usually follow the valleys of large rivers. There are two seasons during which the disease usually occurs. Firstly, the end of the rainy season, that is, February and March, during which period the rivers that have overflowed their banks, come back to normal, and leave open fleis where anthrax spores have been brought to the surface in large numbers. Secondly, the end of the dry season, November and December, when the grazing is very dry, when the *Andropogon contortus* (Danga) is particularly harmful. The dried-up vegetation injures the first portion of the alimentary tract of cattle already weakened by shortage of food, excoriations of the mucous membranes thus caused,

afford easy access to anthrax spores contained in the food. During that period one notes that every animal affected with anthrax shows an oedema of the parotid region. Several indigenous tribes, the Baras, for example, know very well that at this period the best precaution against anthrax is to burn the grass. Serious epizootics do not usually occur in Madagascar probably due to the open-air life led by animals.

All infected animals die in between 24 and 48 hours, but in infected herds there is a comparatively small mortality—10% at the most.

Preventive measures are regulated by the 1903 order, which prescribes for the very deep burial of unopened carcases. In districts remote from administrative centres the meat of anthrax carcases is consumed by natives, and offals, etc., are carried about by dogs, but the infected hides can fortunately, not be sold, for all hides placed on the market must be accompanied by a slaughter permit.

Curative treatment does not appear to exist: the disease is so rapidly fatal that we have never been able to try different drugs such as permanganate of potassium, gold colloid, or acetanilid, as advised by Dr. Chaigneau (Recueil Medecine Veterinaire, 15th November, 1921) nor has it been possible for us to try intravenous inoculations of arsenobenzol, as recommended by Dr. Roux, of Laussane.

Preventive treatment by vaccination gives excellent results. As it is difficult to collect animals from bushy districts within a few days the veterinary authorities have replaced the system of first and second inoculations with Pasteur's vaccine by the single method of inoculation.

The first inoculations of this type, were carried out in 1905. Veterinary Officer Grandmongin, at first had some bad results with Chauveau's vaccine prepared by Dr. Niret and inoculated in the shoulder, although the vaccine was proved not to be very virulent as its fatal effect on guinea pigs was slow, and it did not kill rabbits at all. Mr. Grandmongin thought that possibly what applied to pleuro-pneumonia and blackquarter, might also apply to anthrax: he thought that tail inoculations, which would not facilitate the development of large œdemas, might answer the purpose: he therefore decided to try this, and the inoculation was done on the under surface of the tail, within 10 centimetres of the base: this method is now generally employed by all veterinarians in Madagascar with excellent results.

The dose of the vaccine is one-quarter of a cubic centimetre for oxen, one-sixth for cows, and one-eighth for calves. In 1921, 722,034 bovines were inoculated, and in 1922, 1,000,000 animals were treated out of 8,000,000 head existing in the Colony. Anthrax inoculations are free and not compulsory and are carried out by trained natives under qualified veterinary supervision. Inoculations are: (1), innocuous, as there has not been a single accident since the tail method was adopted: (2), they are efficacious, as in easily supervised herds like European herds, where numerous fatal cases of anthrax occurred formerly, the disease has disappeared since inoculations were regularly carried out. At the beginning of 1923, in the valley of Vohisara near Lake Alaotra, inoculated animals did not contract anthrax, whilst non-inoculated ones died in large numbers.

Immunity conferred by vaccination lasts about one year. At present, through inoculations carried out on a large scale, outbreaks of anthrax are very rare in Madagascar.

The single anthrax vaccine, in the manufacture of which Martin's bouillon is usually employed, cost in 1922, two centimes per dose.

II.—Horses. Horses being susceptible to anthrax the veterinary authorities thought of immunising them. Since 1919, army horses and horses on breeding stations, are inoculated regularly, and privately-owned animals are also treated, if the owners wish it. The immunisation of horses is, however, much more delicate than that of bovines: the animals are first prepared by receiving 20 c.c.'s of anti-anthrax serum, and three days afterwards, one-eighth of a c.c. of the first of Pasteur's vaccine: 10 days after this a quarter of a c.c. of the first of Pasteur's, and again 10 days afterwards, one-eighth of a c.c. of Pasteur's second vaccine. The second inoculation carried out with one-quarter of a c.c. of Pasteur's first vaccine is frequently followed by a large œdema, with high temperature, etc. It is necessary to have a supply of serum handy, so as to be able to intervene in cases where large œdemas develop. One intravenous injection of 20 to 40 c.c.'s of serum at once stops the progress of the œdema. The serum is manufactured at Pasteur's Institute at Tananarive. Serum, even when given in large doses, through intravenous inoculation of 300 c.c.'s was not efficacious in curing the disease when contracted naturally.

The immunisation of horses against anthrax appears to be successful: no cases of anthrax have been noted in treated animals since the inoculations have been carried out. The immunity conferred does not appear to last more than six months. In 1922, one mule, inoculated seven months previously, died of anthrax at Diego Suarez.

III.—Ostriches. Six cases of anthrax were diagnosed in ostriches in 1910, seven in 1911, and six in 1912. In July, 1911, immunisation of these birds was attempted by Mr. Grandmougin: two birds, a male and a female, received one-twentieth and one-tenth of a c.c. of Chauveau vaccine within a period of eight days: nine adult birds were inoculated with a quarter of a c.c. of Pasteur's second vaccine. None of the treated birds were affected by these inoculations, which were carried out under the skin of the thigh: a few of them showed a slight œdema, which lasted about five days and then disappeared.

Was the immunity conferred complete? During five months after inoculation no deaths took place, but in December a vaccinated hen died suddenly from anthrax. One adult cock bird received subcutaneously in the thigh 1 c.c. of virulent blood, collected from a bird dead of anthrax, and showed neither local nor systematic reactions. This bird died two months afterwards from another disease. The ostrich is, therefore, very resistant to experimental infection with anthrax: we believe that this also applies to the naturally contracted disease, and that a number of favourable circumstances must exist for its evolution and fatal termination. It appears that natural infection occurs through ingestion of spores, and that the disease becomes systematic by infection through wounds of the mucous membrane of the alimentary tract.

IV.—Sheep. The native sheep are immune to anthrax naturally contracted, but imported animals and grades are susceptible to the disease. In 1922, inoculation of grade sheep was begun at Antsirabe; they received an eighth of a c.c. of Pasteur No. 1, followed eight days afterwards by a similar dose of No. 2 vaccine.

V.—Pigs. Cases of anthrax are very rare in pigs. One case was diagnosed in 1911 by Veterinary Officer Norim at Tuleur.

Mr. J. Walker: I have listened with great pleasure to Dr. Viljoen and more particularly to what has been said in connection with preventive inoculation.

On my taking over the Kabete Laboratory, no anthrax vaccine was available for issue. 'Necessity being the mother of invention,' we got to work and prepared a vaccine.

I had previously seen the preparation of a spore vaccine at Onderstepoort, but since no facilities existed at Kabete for preparing a vaccine by the method in use there, and recognising that the anthrax organism is an aerobe, and grows and sporulates in bouillon under ærobe conditions, a spore vaccine was prepared by cultivation of the Pasteur attenuated organism in bouillon.

The use of this has given satisfactory results in the practice, and as far as I am aware there are few, if any, instances in which serious swellings have followed its use or in which breakdowns in immunity have occurred.

I would like to ask Dr. Viljoen whether he recommends the use of the spore vaccine as prepared at Onderstepoort on farms on which the disease does not exist: it seems to me that there is a possibility of anthrax being established should it be used on clean farms, and whether it is recommended for the inoculation of milch cows and transport oxen?

I agree that there is a considerable amount to be learned in connection with the biology of the anthrax organism, and the fate of the spore in the presence of soil bacilli, and other organisms such as Protozoa, etc.

With regard to the transmission of anthrax under natural conditions: so far as I am aware stomoxys have not been found to be carriers in Kenya Colony, but the fact that stomoxys have been found to be implicated in the transmission of anthrax in South Africa, and I believe results of experiments carried out elsewhere shew that tabanidæ may be carriers, it is reasonable to conclude, that stomoxys or other winged insects probably play a role in the spread of anthrax in Kenya Colony.

Could Dr. Viljoen tell us, for how long after feeding on an infected animal can the stomoxys transmit anthrax?

Dr. J. B. Botelho: The first case of anthrax appeared in Portuguese East Africa in December, 1918: all cattle in the areas infected were vaccinated: the vaccine was supplied by the laboratory at Onderstepoort. But, as new cases every week were reported, I proposed to my Government the vaccination of all cattle, about 200,000 animals, of the Lorenco Marques and Gaza districts. The new spore vaccine is very good for cattle. I am very satisfied with it. It is not good for goats. A stock inspector vaccinated over 40 goats, and all died.

Anthrax has not been diagnosed in sheep, goats, horses, or mules; only in cattle: one outbreak occurred in pigs.

I hope that anthrax does not invade the adjoining district of Tubambame, because all cattle in infected areas have been vaccinated.

Mr. W. M. Power: In Natal, the disease occurs principally amongst cattle, but cases have been met with in horses and small stock. In badly infected areas, an effort is made to have all newly introduced stock vaccinated soon after arrival.

The greatest means of spreading the disease in the Union, is undoubtedly the carrying of infected material by natives. What happens in practice is, that Europeans who take the precautions of sending smears for examination do not always suspect anthrax, with the result, that they allow their natives to cut up the carcase and distribute the meat on their own farms and those of others, and it is not known for about a week that it is anthrax.

Dr. Viljoen also refers to compulsory inoculation, and mentions that this would probably involve whole districts. I am not aware to what extent it is proposed to carry that out in districts where only isolated centres of infection exist.

I wish to ask Dr. Viljoen if he has now any more precise information as to the period of incubation of the disease.

I may say, that we have used spore vaccine ever since it has been issued, now nearly two years, with very satisfactory results. Cases of the disease continually crop up. We are now using it on a large scale, and the only feature about which we have received any complaint, is on the question of swellings which are severe in some cases.

Captain R. H. Knowles, R.A.V.C.: It might be of interest to you to hear about anthrax in the Sudan. Up to November, 1921, we regarded the Sudan as being free from anthrax, as only one case had occurred thirteen years before in an imported bull. In November, 1921, anthrax was reported in exported Sudanese cattle at Shellal. Within intervals of five days to a week, it gradually spread down to the Sudan, and it occurred in the quarantine stations at Halfa and Khartoum. It was thought that the infection was carried down from Egypt. The first cases of anthrax were in cattle which had been in the quarantine for over 18 days, and so were infected in the quarantine at Khartoum. Cases of anthrax continued to occur from November until the following March. No case occurred, however, outside the quarantine stations, except in one outbreak in Nuba Mountain Province, 300 miles south of Khartoum. This outbreak occurred in animals of a nomadic tribe, and involved the death of 30 cattle, 4 donkeys, 5 horses, 36 sheep, 1 camel, and 2 women.

The disinfection of our quarantines is a difficult matter as the flooring is plain earth. This disinfection is carried out by burning grass on the flooring.

The other point I wish to bring forward, is the incidence of anthrax bacilli in the blood. We generally thought that in cattle, anthrax becomes a septicæmic disease shortly before death, and that the presence of the bacilli in the blood presents a comparatively easy method of diagnosis by microscopical examination alone. Dr. Archibald, the Director of the Wellcome Tropical Research Laboratory, Khartoum, reports in the *Journal of Comparative Pathology*, 1922, that in 20% of cases of anthrax in cattle, he could not detect the anthrax bacilli in the blood by microscopical methods alone, and that cultural methods were necessary to diagnose these cases. It, therefore, presents a question of very great importance from a diagnostic point of view. I would like to ask if any statistics are available to elucidate this question. I think it will be found that Dr. Archibald's experience is not universal and that 20% is a very high figure for fatal cases of anthrax in cattle, in which the bacillus could not be found by microscopical examination alone. At present I am keeping statistics in fatal cases of anthrax in order to find out, over a considerable number of cases, the percentage of cases in which anthrax bacilli cannot be demonstrated by microscopical examination alone, but can be found by cultural and biological methods. We know that in fatal cases of anthrax in horses, the percentage of cases in which the bacilli cannot be found by microscopical examination alone, is much higher than in cattle.

Mr. F. J. McCall: Anthrax is not one of our disturbing problems in Tanganyika as no definite case has ever been diagnosed there: this is not for lack of searching for the disease, as slides are sent to the Laboratory from all animals slaughtered in the various abbattoirs, and also from all animals which die suddenly from any suspicious cause. When in Kenya, I well remember its frequency in the Lumbwa and Kisii districts where the natives knew of it as 'Brasta': amongst these people at one time malignant carbuncles were frequently observed. This being the case, it is only reasonable to assume that anthrax also occurs across the Kisii border in Urege and the Utende country.

Mr. H. E. Hornby: Is anthrax present throughout Central Africa? We are aware that many diseases have come from Central Africa, but I think that anthrax is one that has not existed from time immemorial in Central Africa.

I think it is being introduced into Central Africa now. It may have been introduced into South Africa from Europe, and into Egypt from Asia, and it is probably only a question of time before it becomes prevalent in Central Africa. It is very much in evidence in north-west Rhodesia, but it has not been proved to occur in north-east Rhodesia. No cases have been reported in Nyasaland, I think, and in Tanganyika if it does exist, it has not been discovered definitely.

THE CHAIRMAN: I think we must agree that anthrax has existed here for a great length of time, and has assumed serious economic importance in the country. I would like to ask Mr. Walker or Mr. Kennedy, whether a case was not reported in an elephant some time ago?

Mr. J. WALKER: I do not know of this.

THE CHAIRMAN: Mr. McCall mentions what should be an important thing for us to discuss, viz.: malignant postule of man, in relation to anthrax of animals, which occurred during the war. Anthrax in cattle was rife in the Colony, at the time, and a number of natives developed it, but nearly every native recovered. It is possible some natives contracted the disease from eating the meat.

I am very interested in hearing Captain Knowles speak of the difficulties of diagnosis.

At one period here, during the war, a considerable mortality was experienced in military camps, and it was found that smear examination did not always reveal the cause of this disease. Collection of specimens were made with sterile cotton wool swabs in addition to smears and in some cases the swabs were positive to anthrax and the smears negative.

After using some 40,000 odd doses of a vaccine prepared at the Kabete Laboratory, a batch was used on a valuable stud of racehorses where no infection previously existed. Something like half the number of the inoculated animals died after vaccination. This batch of vaccine was prepared in identical manner to that of all previous batches. We had prepared, at that time, a quantity of anti-anthrax serum, and I am convinced that it saved a large number of the animals which recovered. There was one animal which subsequent to vaccination, showed no ill-effects for something like three or four weeks; a large swelling then appeared and the serum appeared to bring about recovery.

Mr. W. KENNEDY: The disinfection of hides, intended for export is an important matter. I understand there is a growing tendency on the part of hide-importing countries to endeavour to exclude the risk of anthrax infection in hides, and I think that any country which wishes to have access to the best hide markets in future, will have to adopt some system of hide disinfection.

I think Mr. Walker has gone over the main points with regard to anthrax in this territory: the animals commonly affected are cattle, pigs, and in parts of the Northern Frontier Districts, camels.

Cases have come under notice in game. Sometime prior to the outbreak of war an outbreak occurred near Nairobi, and the Game Warden found about 20 carcases of hartebeest on the veld: material was only collected from one or two, but this sufficed for the purpose of diagnosis. For some considerable time afterwards no hyænas were to be found in that neighbourhood, and it was thought these animals had also succumbed to the disease. The Game Department has reported suspected outbreaks of anthrax among elephants, but the disease has not been definitely diagnosed in these animals in this Colony.

Control measures with regard to anthrax in this country are similar to those in Natal: our veterinary officers have similar powers, and, when an outbreak comes under notice, carcases are suitably disposed of and vaccinations are carried out.

I must corroborate Mr. Walker's statement that the vaccine produced by the laboratory at present has given excellent results. A few deaths occur after the first vaccination, but a satisfactory immunity usually follows the second vaccination.

One aspect of the question of compulsory inoculations which might be considered by this Conference from an economic point of view, is the cost of such annual inoculations, whether it be borne by the State or by the owner.

An estimate was made in this country recently, that the cost of dipping and inoculating an animal against rinderpest, anthrax, pleuro-pneumonia, blackquarter, and white scour, during the first four years of its life—I am referring to bullocks particularly—approximates the commercial value of the animal.

Mr. H. H. BRASSEY EDWARDS: I wish to state I have had extensive experience of the use of the vaccine, as prepared at Kabete, in inoculating infected herds, and I can speak as to the efficiency of the vaccine. The immunity appears to last for one year.

Anthrax is very prevalent in certain native reserves in this country, particularly Machakos, Lumbwa, Nandi and Kavirondo.

Dr. P. R. Viljoen: I have listened with a great deal of interest to the remarks made by the different delegates. Commencing with the remarks made by Major Tissié: It is very interesting to hear that native sheep and goats in Madagascar do not contract the disease: I should like to know whether these animals have been shown to possess natural immunity against the disease, by experimental methods. When I spoke on this point before, I told you that I was of the opinion that on quite a number of infected farms animals contract mild attacks of anthrax, and that they recover from the disease without any visible symptoms of illness being observed. In this way immunity is set up.

I was very interested in the plant in Madagascar that is stated to cause injury to the mucous membrane of the stomach and intestines, and in that way allow the penetration of Anthrax spores, and their absorption into the general blood system. I think it is fairly safe to assume that practically every animal has got some injury in the enormous surface which the mucous membrane of the intestinal tract presents. Experimentally, it has been quite easy to transmit the disease by introducing the organism per os. Only recently to satisfy myself, I gave anthrax spores in the drinking water to some cattle, and there was no difficulty in producing anthrax infection successfully. Infection did not always take place, particularly when only small quantities of spores were used.

Major Tissié mentioned the question of treatment, and I may say that curative treatment of anthrax nowadays presents no great difficulties. There are two definite ways of curing the disease and these methods are particularly successful in the human subject, because the disease runs a more protracted course, and there is time to apply the treatment. The one method is the administration of a good anti-anthrax serum: I use the word 'good' advisedly because there are so many anti-anthrax sera that are not of any great value. With the serum that we have prepared at Onderstepoort, I have been able to cure cases in horses, in doses of 50 to 100 c.c. injected intra-jugularly. The treatment has not been carried out on an extensive scale for the simple reason that the preparation of the finished product is rather an expensive one, and the horses we had to deal with were not of very great value, but from the short experience I have had with this treatment, I feel quite satisfied that the disease can be cured in many cases with a good anti-anthrax serum. The second method referred to is drug treatment: it has recently been found in Pretoria that salvarsan is practically a specific. I do not think that anthrax in the human subject is feared at all nowadays where this treatment is known. A little while ago at Onderstepoort we had a very bad case of anthrax in one of our assistants; the infection in this case took place in the lip, and as you are aware any infection in the region of the head is always dangerous, particularly so in the region of the throat or mouth. In this case the anthrax lesion rapidly extended to the tongue, throat and mucous membrane of the mouth, with the result that the patient presented an awful sight within a few days after infection. He was sent to hospital, where the salvarsan treatment was applied, and recovery took place very quickly. As far as I remember he was out of hospital within a week or two. Only a slight scar remains to-day at the point of infection, but no real disfigurement was caused. As far as I am aware, surgical interference was not considered necessary. In animals we have not tried this drug to any extent, because it is far too expensive to be used on those subjects.

Major Tissié raised the question of introducing the vaccine into the tail. It is well known, *e.g.*, in the case of pleuro-pneumonia, and in blackquarter, that the path by which the vaccine is introduced into the body, affects the subsequent results to a great extent. I quite believe that tail inoculation would do away with the greater part of the danger connected with swellings. For cattle and sheep, as I mentioned before, there is no need for us to select any special site of inoculation, because swellings are never very frequent, and where they have occurred at all they have not been found to be dangerous. For horses, we have also considered the question of tail inoculation, but have so far not applied it in practice, for the simple reason that in South Africa the inoculation is done by the farmers themselves and the tail inoculation certainly presents some difficulties. Even as it is, with the old method of subcutaneous injection in the neck or other part, with the small quantity of vaccine that is used, it often happens that farmers do not get the right quantity of vaccine into the animal, and it is reasonable to assume, with the tail inoculation many animals will escape receiving the proper dose.

The period of immunity resulting from vaccination is another important point mentioned by Major Tissié. We have carried out numerous experiments with our vaccine in this connection. Generally speaking the immunity lasts for about 12 months; it is very strong in all animals for about six months, but after that period it begins to decline: there are cases where horses have been tested from 12 months up to 20 months after vaccination, and in some of these cases, immunity was proved to be present even after such a long period as 20 months. There is not the slightest doubt that in some animals the immunity lasts for a very long period, but from the practical point of view, it is necessary to consider the immunity to have decreased to such an extent that annual inoculation is indicated. I may say that a large number of experiments have also been carried out with other vaccines, notably the Australian spore vaccine, and practically the same results were obtained, that is to say, the immunity lasts approximately 12 months.

It was interesting to hear that in Madagascar they also had trouble with the inoculation of horses. I have previously discussed the sero-vaccination that is apparently being employed in Madagascar, and have pointed out that the immunity set up by this method has so far not been shown to be a very good one, and for this reason it is not being applied to any extent by us. Moreover, spore vaccine has given on the whole fairly good results in horses, and one need only make a weaker vaccine for these animals if deaths should result after the use of the ordinary strength vaccine.

It was mentioned that deaths occurred after rains, subsequent to inoculation, but I did not hear how long after vaccination these deaths took place.

Major P. Tissie: Generally next morning.

Dr. P. R. Viljoen: If they occurred within 24 hours, it is difficult to find an explanation, because the incubation period of anthrax in horses is much longer than that, and the vaccine does not produce its effect so early.

With regard to Mr. Walker's remarks: I was pleased to hear he had obtained such good results with his own vaccine. From what he has also told us, there is very little doubt, that he also is dealing with a kind of spore vaccine, in which case one certainly would expect favourable results. As I mentioned before, vegetative forms of the organism do not live very long, and it is owing to this fact that the ordinary Pasteur vaccine gives unsatisfactory results.

I am not in a position to tell Mr. Walker how long the infection remains alive in the fly. We found great difficulty in keeping these flies alive: when picked off the animal and removed they rapidly die, and for this reason it has been difficult to determine the period of infectivity, although personally, I do not think it will be very long.

I have had no experience whatever of anthrax in the camel and cannot remember just now what the literature says on the subject.

I have not the slightest hesitation in recommending spore vaccine on clean farms, for the simple reason that the vaccine is made from properly attenuated organisms. Whether such organisms are injected into the animal in the spore form or the vegetative form, the results are the same. When the animal dies as a result of the spore vaccine, bacilli are present in the blood and tissues; the spores which are injected under the skin, do not invade the body until they have vegetated, and multiplication of the vegetative forms takes place. It is well known that anthrax baccilli lend themselves to proper attenuation, a fact accepted all over the world, and I must say we have not found this to be different: we have killed animals with spore vaccine quite frequently, and in all cases, where the organisms have been isolated from the carcases, it has invariably been found that they retain their attenuated properties. Should an animal, therefore, die on a clean farm, as a result of spore vaccine, I do not for a minute anticipate that anthrax infection can take place. It is true enough that if the carcase were opened and the organisms were allowed to sporulate, the farm can become infected, but I do not see the slightest chance of an animal becoming infected by picking up these organisms. Even if it did, the organisms would still remain attenuated, so that one could never get back to virulent anthrax from such deaths. The vaccine can be used in milking cows and working oxen, the same as any other vaccine; the only thing there is, that if the vaccine is strong, the milk supply will be decreased while the re-action is on, and working oxen are inclined to develop swellings while undergoing the reaction. As a matter of fact, we recommend the milder vaccine for these animals, the double method of inoculation, in which the effects are not so severe.

I remember our laboratory making large issues of vaccine to the Portuguese territories and I am very pleased the results were so good in cattle. I have made it quite clear that the ordinary single spore vaccine is not recommended for use in goats and I can quite believe that heavy mortality was experienced in goats in Portuguese East Africa.

By compulsory inoculation, I meant general compulsory inoculation, as a means of controlling and eradicating anthrax. I mentioned that this method of dealing with the disease is under consideration, but what the final details of the method will be I naturally cannot say. From what I have said about the use of the vaccine on clean farms, you will realise that there can be no objection in doing the animals in a whole district or province if necessary.

It is true that animals suffering from anthrax may excrete the organisms in their fæces, but I do not think this is a very important method of spreading disease, for the simple reason that one cannot conceive that the number of spores so discharged could be very large, and animals in order to become infected, require a good many spores under natural conditions. If, on the other hand, it should be found that these spores could multiply in the soil, then this must be considered an important way in which the disease can spread, but this point is not cleared up at all, and the facts are rather against it.

The incubation period varies enormously, depending on the number of spores injected and on the susceptibility of the animal. Experiments shew that it varies from 24 hours to 14 days.

I was extremely interested to hear about the diagnosis of anthrax in the Sudan. Unfortunately, I have not seen the articles in question, but it seems extremely difficult to believe that failure to detect the organisms microscopically in the blood of cattle, could occur in such a large percentage of cases. Our experience is that it appears in septicæmic form in cattle. Even if it does not—and I can remember cases where cattle have been sick for three days or longer—the blood is still very rich in organisms. Generally speaking the more rapid the course of the disease, the more frequent the bacilli would be in the blood after death. I remember cases where other people failed to detect bacilli in the blood of horses, and the smears were submitted to us for microscopic diagnosis and we were able to demonstrate a few anthrax bacilli in the blood. Sometimes bacilli only appear singly in the blood of a horse, and one would have to have experience before a positive diagnosis could be made.

I have already mentioned the treatment of anthrax in the human subject, and I may also mention that it is certainly not a fatal disease in ordinary circumstances.

Mr. Montgomery mentioned that many cases recovered under treatment and I think that is a common occurrence in South Africa with natives.

Mr. Kennedy raised the question of the cost of vaccination. I am of the firm conviction that it is no use charging the farmer anything if one really wants to eradicate the disease by compulsory vaccination. The only way is to supply the vaccine free, so that he could have no excuse for not having the vaccination carried out. We have certainly found in the Union that it has paid handsomely to render free services to farmers when outbreaks of dangerous diseases have to be dealt with.

The Chairman: What is the present cost of your vaccine, and how long does it remain good?

Dr. P. R. Viljoen: We sell it at S. 30 per 100 doses, and it remains good for a year at least, but we do not allow the farmer to keep it for more than six months. Twenty-five per cent. is added to countries supplied outside the Union.

RESOLUTIONS.

Anthrax.

1. This Conference recognises the great economic importance of this disease and the necessity for taking effective measures for its control and eradication by:—

(*a*) Proper disposal of infected carcases.

(*b*) Vaccination of stock in infected areas with a reliable vaccine.

2. In view of the existence of gaps in our knowledge of the viability of the causal organism outside the animal body, it is of the opinion that further research is highly desirable.

A. SPECIFIC ANIMAL DISEASES.

(7) Blackquarter (Quarter-evil).

Dr. P. R. Viljoen (Sub-Director of Veterinary Education and Research, Pretoria): Now, as regards blackquarter I do not intend saying a great deal. The greatest problem in connection with this disease is undoubtedly the best method for control and eradication.

Blackquarter is a very widespread disease in South Africa occurring in practically all parts of the Union. Some years it appears to be much more severe than in others and even in the same years, the disease sometimes presents a seasonal distribution.

The causal organism, as you are aware, is a small bacillus usually occurring in the spore form. It is a very strict anærobe. It is usually accepted that the organism is an ordinary soil saprophyte, but I do not think that we can accept this as an established fact or as having been proved scientifically. We know that the disease is confined to certain parts of the farm, that is, there are infected places on certain farms, and it would appear, therefore, as if the infection very often remains localised and as if the organism does not multiply to any great extent outside the animal body. In our experience in South Africa, we have found quite a number of different strains of the blackquarter organism, some much milder than others.

The most fruitful source of infection is the carcase of an animal that has died from the disease. The organism is found particularly in the affected muscles, but also occurs fairly abundantly in the spleen and in the blood stream. When an animal dies from the disease and the carcase is left lying on the veld, it can be understood that infection is allowed to spread.

The animals affected in South Africa are mainly cattle and sheep. Usually disease attacks only young cattle, particularly between the ages of six months and three years, but when the disease appears in a virulent form or when the farm is badly infected, cases are commonly met with in very young calves, even as young as only a month old, and quite old animals can also contract the disease.

The method of infection in cattle is not definitely known. The organism can enter the body either through the mouth, that is, by ingestion of infected grass, water, etc., or it can enter through wounds of the skin. Experimentally it is extremely difficult or almost impossible to transmit the disease by giving the infected material or organisms by the mouth. By introducing the organisms under the skin the disease is easily set up in either cattle or sheep. In practice, however, it is very rare that one can find any skin lesions in an animal that has died from the disease. It is possible naturally that the wounds or abrasions through which the organisms enter the body may be situated internally, in the mouth, or in the intestinal tract, so that, in that case, the method of infection can be said to be a combined one, *i.e.*, both ingestion and wound infection occurring at the same time. As regards sheep the disease in South Africa makes its appearance in these animals only after shearing, castration, or other operations carried out on this class of stock. The most common way in which blackquarter makes its appearance in sheep is when shearing or castration is carried out in a shed where calves have been kept or where skins of infected calves have been dried. In South Africa it is a common practice for calves to be kept in open sheds during the rainy weather, and also for hides to be dried in these places. In that way the sheds can become infected. Very often the disease in sheep appears in quite an epizootic form, owing to the infection being spread in this way, the organisms entering through the wounds made by the shears or the castration wound. As you are aware sheep are extremely susceptible to the disease experimentally.

Now proceeding to the question of control or eradication of the disease, it must be mentioned that there are two main methods that must be adopted. The first one naturally is the proper disposal, of carcases of animals that have died from this disease. In this case, spores are already present in the animal before death, so that whether one cuts into the carcase or not the spore formation is not affected to any extent, but all the same by interfering with the carcase the bacteria will naturally escape and so infect the surrounding veld. It is necessary, therefore, to interfere with the carcase as little as possible and to either bury deeply or still better to burn it, for in this way the spore are certainly destroyed, whereas by burial they may remain alive for very long periods. It must be mentioned here that we do not know the fate of blackquarter organisms outside the body. How they live in the soil or at what depth they can exist, whether multiplication takes place there to any extent; all these points remain obscure and require early investigation. Until we have a clear conception of the mode of life of the organisms outside the animal body there can be no question of successful attempts at eradicating the disease completely.

The best method and the most practicable method of controlling the disease is by preventive inoculation. There are two main forms of vaccine that I wish to refer to. The one is the powder form of vaccine, which as you know is a very old method and I may even say an old-fashioned and unscientific one. I need not go into details regarding the preparation of this particular form of vaccine, since you are all fully acquainted with it. The main disadvantages of a vaccine of this nature are, firstly, that it is difficult to have it properly standardised: secondly, that it offers enormous difficulties to the farmer to handle in a satisfactory way. As you are aware, the powder is put in small tubes or ampoules, each containing ten doses. This powder is mixed and emulsified in water and then the ten animals are injected with the same syringeful. It is very difficult to make a proper and regular suspension of the organisms contained in the powder, in a liquid. The result is that when the ten animals are injected with one syringeful, it is almost certain that some will be receiving more spores than others and a few may, and I can say often do not receive any vaccine at all. This is a most unsatisfactory position and quite a number of breakdowns usually occur after the use of this vaccine.

Owing to these difficulties and owing to the unsatisfactory form of the vaccine, during the last few years we have been making extensive observations and experiments to find a suitable and reliable vaccine in liquid form. At the present time we are actually issuing such a vaccine to the farmers in South Africa. A liquid vaccine can be made in two different ways, and one refers to them as artificial aggressins and natural aggressins, respectively. By agressin is usually understood the endo-toxins contained in, and given off by certain bacteria. These

toxins have an aggressive action in the animal tissues and for that reason this name was applied. When they are injected into the animal, anti-bodies are formed and immunity is set up in the animal. This immunity may be termed an anti-toxic immunity. Artificial vaccine is prepared very easily and simply. All that one requires to commence with is a pure culture of the organism. As you are aware, during the late war an enormous amount of work has been done on the cultivation of anærobes in general, and as the result of that work, we are to-day in a position to grow anærobes easily and to study them properly. Having got a suitable strain and a pure culture of the organism, one simply inoculates large flasks, say about 10 litre flasks, containing glucose liver bouillon. This, as you know, constitutes an anærobe medium. Provided the inoculation of the medium is done in a sterile manner no growth will be visible for the first 24 hours. Growth resulting from the blackquarter organisms manifests itself in cloudiness of the medium and bubbles of gas rising to the surface. The cloudiness disappears in four or five days, the organisms settling down to the bottom of the flasks. The cultures are allowed to remain in the incubator for two or three weeks, but I may say the optimum time of incubation has not been quite definitely settled. The idea is naturally to get as much toxin as possible. The liquid part of the medium is filtered through bacterial candles in the ordinary way, with the object of obtaining a germ-free filtrate. The filtrate, so obtained, is tested first of all for sterility, the method employed being both cultural and animal inoculation. This bacterial filtrate constitutes the so-called agressin, one-half per cent solution of carbolic acid is added as a preservative and the vaccine is put up in the required size bottles, etc. Before being issued, it is carefully tested in sheep for the degree of immunity set up. In this connection I may say, that in other countries and with the old powder vaccine, it was not usual to test blackquarter vaccine for immunity produced in animals: the only test applied being to make sure the vaccine did not kill the animal. Our vaccine is tested, not only for its safety, but also for its immunising properties. The dose of this vaccine is 5 c.c. for a calf and it protects animals for at least six months against the disease. It has been used for at least a year in the Union and I may say that in the beginning it was issued only to the worst infected farms in the country, only in those places where the old powder vaccine did not protect, and the results in those cases have been entirely satisfactory. After the liquid vaccine was supplied, mortality on these farms ceased completely, and up to the time of my departure from Pretoria, there was not a single case known where complaints had been received of breakdowns having occurred in animals inoculated with this vaccine.

Now I would like to say a few words about the other form of aggressin. It is so called because it is produced in the animal itself. When one injects an animal with blackquarter organisms, a toxin is formed in the infected part of the animal, that is, in the diseased muscles. The method of preparation of natural agressin vaccine is as follows: One injects a good, healthy calf with large doses of black-quarter bacilli in the large muscular masses of the body, that is, the hind-quarters and along the back. The animal so injected will die of the disease within two or three days, and one endeavours to be present when death actually takes place, so as to gather the material in a perfectly fresh state. Sometimes it is necessary to kill the animal in the last stages of the disease, for the purpose of collecting fresh material. All the muscle juice and the affected muscles themselves are collected and passed through a meat press, in order to squeeze out all the juice that is present in these muscles. This juice is collected and contains large numbers of organisms together with their toxins. Such a liquid when injected into animals in small doses would produce quite a strong immunity, but in most cases the organisms present are too numerous, and as a result the injected animals are killed. It is necessary, therefore, to have as few organisms as possible in that liquid. I may say at once that it is an extremely difficult matter to obtain a germ-free filtrate from this material, for the simple reason that it is of a highly albuminous character and cannot be easily passed through a bacterial filter. Small quantities can be obtained quite simply, but we naturally require very large quantities for practical use in South Africa. To overcome this difficulty we have adopted another method. There is in existence a so-called super-centrifuge of American production, which is driven by steam and which runs at a speed of 40,000 revolutions per minute. This centrifuge is on the principle of the ordinary cream separator. By passing this albuminous fluid through the centrifuge three, four, or more times, a large percentage of the organisms are taken out of the fluid, but it is not possible to render the fluid quite or nearly bacteria-free. However, when it is given to calves in small doses, say, two or three c.c.'s; a very strong immunity is set up. This vaccine has not been issued for general use as yet, one of the reasons being that the other, previously referred to, has given such satisfactory results, but there is not the least doubt that this form of vaccine will produce a far stronger and more lasting immunity than the other. In the case of the other I have mentioned, we have to deal with an anti-toxic immunity. In addition to the anti-toxic immunity we also obtain an anti-bacterial immunity set up by the few organisms present in this vaccine and hence we have an immunity which is of a more active and, therefore, more lasting character. From this you will realise that it is not undesirable to have a few organisms in the vaccine.

I shall complete my remarks by simply referring to further research work that is required in connection with this disease. The one important point to consider is the habit of the organism, its mode of life in the soil, its method of spreading, etc. The second point which requires elucidation is the method of infection, whether it takes place through wounds, etc., and thirdly, the improvement of the liquid forms of vaccine which I have endeavoured to describe to you. Improvements in vaccines will always be necessary; I cannot foresee a time when we shall be able to sit down with the satisfaction that we have a perfect vaccine. Experience has shown that there will always be room for improvement, the reason for this being that many factors come into the preparation and use, etc., of the vaccine, and after all, we must not forget that in the case of most vaccines we are dealing with live products.

Mr. W. Kearney: There are one or two questions I should like to ask Dr. Viljoen to reply to. Would he please state if possible, why the disease is seasonal? Does he test his candles before passing the aggressin through in the preparation of the vaccine and how is the immunity test made after inoculating the aggressin into the test animals?

A peculiar fact which Dr. Viljoen speaks of, is the prevalence of the disease amongst sheep in South Africa. We have never had in my experience, a case reported at Kabete, although we have had suspected specimens for examination. No doubt sheep are susceptible in this country. We have proved it so in the preparation of our vaccine.

Might I suggest that wound infection is possibly the more common means of the disease being contracted, since the muscular masses of the limbs are most commonly affected.

Mr. H. E. Hornby: I should like to ask Dr. Viljoen what instructions are issued to District Veterinary Officers, or Stock Officers, as to the way in which they should send material to the laboratory from animals suspected to have died from the disease?

Dr. J. B. Botelho: In Portuguese East Africa there have been cases of blackquarter. The first case occurred in 1919. Vaccine is supplied from the laboratory at Onderstepoort. The results have always been found to be very good.

The Chairman: Is there any blackquarter in Madagascar?

Major Paul Tissie: No.

Mr. J. T. C. Bradshaw asked is it possible to kill off the bacteria contained in the agressin by a process of heating?

The Chairman: I would like to correct the impression which has been conveyed that blackquarter has not occurred in sheep. Blackquarter has occurred in sheep in this country. There were many cases of the disease, and as Dr. Viljoen says, it appeared in an epizootic form following shearing.

I must agree with Dr. Viljoen that the old method of vaccination must by itself be unsatisfactory. I might suggest that there are possibly separate species of organisms producing different mortality or different action in infected animals.

Might I ask Dr. Viljoen whether it would not be possible to supplement his artificial agressin by dead bodies of bacteria and so improve it. It is, of course, absolutely correct to say we shall never reach finaity in the preparation of this vaccine either in quality or curative effects, and it becomes more and more important to us to consider the price and cost of preparation. The immunisation of animals against contagious diseases is now becoming universal. If you count the total cost of vaccinating a beast against the various diseases with which vaccination is applicable, it comes to a no inconsiderable sum.

Mr. F. J. McCall: We had a report from one of our districts in Tanganyika of the presence of blackquarter. The report was sent in by a stock inspector, but was not confirmed: I think it does exist.

The Chairman: Has this disease been met with in Uganda?

Mr. E. Hutchins: No cases have been confirmed of blackquarter in Uganda. It has been reported in the Mount Elgon district. I think, if I remember right, you had a case at Kabete in some cattle which came from Uganda. This particular animal died on the night of arrival at Kabete. However, we have not yet definitely diagnosed the disease in Uganda.

The Chairman: Any cases in the Sudan?

Captain R. H. Knowles, R.A.V.C.: No, it has never been detected in the Sudan.

Mr. H. E. Hornby: From the recent remarks, it appears that the distribution of blackquarter in Africa is similar to that of anthrax and that many parts of Central Africa are free from both. That such clean areas exist is shewn by the severe nature of the disease when it swept through Southern Rhodesia in 1919-1920. Its progress from the south to the north, and from the west towards the east was marked by a heavy wave of mortality. I remember seeing a number of cattle lying dead on the veld in one part, and then a month later, a few miles further west, the same thing was seen again. The disease then destroyed animals of all ages, but it has now settled down to its usual form.

The Chairman: In connection with Mr. Hornby's suggestion that these two diseases are not very common in Central Africa, we must bear in mind that the veterinary organisations in these countries are of very recent origin. Further, native owners are very apt to ascribe all cases of sudden death to snake bite. Such happened, when blackquarter first occurred in Southern Rhodesia. These are points one should keep in mind.

Has blackwater been found in Nyasaland?

Mr. J. A. Griffiths: It has not been diagnosed up to the present

Mr. J. T. C. Bradshaw: I would like to corroborate the Chairman's statement with regard to the disease in this country. There was an outbreak of blackquarter in sheep, in the Naivasha district during Mr. Kearney's absence on leave. The outbreak occurred after shearing, and a considerable number of animals died.

Dr. P. R. Viljoen: It has been mentioned by Mr. Kearney that the results with the powder vaccine have been extremely satisfactory. We also have had fairly satisfactory results, but owing to the large areas we have to deal with, and the enormous amount of vaccine that is being used in the Union, we are more likely to meet with unsatisfactory results, and I think, that if he had to supply a million doses a year that he would also have rather bad results in some cases.

The liquid vaccine has been found more satisfactory. With its use every animal, with a reasonable amount of care with the inoculation, will receive a correct dose, because the vaccine is in liquid form, and the dose is large, *i.e.*, 5 c.c.'s, so that even a layman is able to inoculate his animals properly. Not only that, but the vaccine is very simple to prepare, and the costs are extremely low. There is really no large expense connected with it: it is only a qustion of culture media, and the material for that one is able to obtain from the post mortem room. It really means only a few experimental animals which are used in the immunity tests, and naturally the actual work put into the preparation has to be considered, but you will realise this does not amount to very much.

It is difficult to give an explanation of the seasonal distribution of the disease, and I am afraid we shall not be able to find a satisfactory explanation until we know more about the mode of life of the organism outside the body. The seasonal distribution probably is connected with the climatic conditions, heat, moisture, and more particularly with the rainfall. We have no definite statistics on this point, but it is quite conceivable that rain, and especially tropical rains, would have the effect of washing out of the soil organisms that may be lying dormant a few inches below the surface.

The bacterial candles used in the preparation of the vaccine are carefully tested: this must be done, because the organism one has to deal with is a small one, and unless the candles are perfectly good, they are almost certain to pass through.

The immunity test is a very simple and inexpensive one. One employs not more than about six sheep to test a batch of vaccine. Approximately half this number are injected with large doses—20 c.c.'s, and the others with the usual doses, in order to satisfy oneself that the vaccine can be safely used in actual practice. About fourteen days after the animals received the vaccine, virulent material is injected into them. We now use ½ c.c. of pure culture 48 hours old. The culture used is made in so-called Hibler's brain medium, in which the organism grows profusely. We have under consideration now, the preparation of another testing material, *i.e.*, growing an organism on this medium and getting rid of the liquid afterwards by evaporation, etc., and then using the solid part, in which the spores are abundantly present, for the test.

It is possible that wound infection may play a great part in animals contracting the disease, but I must say that my own experiences have been that even if one specially looks for wounds in the limbs of dead calves, it is extremely rare to find even the slightest sign of abrasion on the skin. I am not quite clear what information Mr. Hornby requires in connection with the instructions.

Mr. H. E. Hornby: In what form is muscle for diagnosis sent to the laboratory.

Dr. P. R. VILJOEN: As you are aware smears are made from the affected muscle. We almost entirely rely on smears for diagnosis. If there is a suspicion of another infection from which the animal might have died, then it is impossible to diagnose by that method only. In cases like these one requires a piece of the affected muscle sent to the laboratory. If the muscle material can be sent to the laboratory to reach it in a fairly fresh state, then it need not be preserved in any way. In South Africa this is not usually possible, as the material has to travel considerable distances, and for that reason we always ask the farmers to make "biltong" from the affected muscle. It is not salted in this case. This "biltong" is used for examination and for inoculation into guinea pigs.

Blackquarter can be distinguished from malignant œdema very easily by injection of infected material into guinea pigs. Without going into details, I need only mention that after the death of the guinea pigs, if smears are made from the liver surface, and examined microscopically, in the case of the latter disease, the organism will appear in long strands as compared with the very short threads or single bacilli in the case of blackquarter.

Mr. Bradshaw suggested killing off the bacteria contained in the aggressin fluid by the process of heating. We are considering that, but the danger is simply that the toxin which is an essential part of a vaccine, will be destroyed before the organisms are killed.

There are various strains of blackquarter in South Africa, and in various parts. Even quite recently, we had a strain that seemed to be very mild, and with which we failed to kill sheep in the ordinary way. I personally, was very pleased to find such a strain, because vaccine production would have been a simple matter, inasmuch as in this case a good immunity was set up, although the disease did not prove fatal. However, after working further on the strain, and passing it through calves, it was found that the virulency had increased: I was very disappointed at the time that this happened. Why it should afterwards appear in a virulent form is quite impossible to explain.

I absolutely agree with the Chairman, that a good deal of further research into this question is desirable, and I may say we, in South Africa, are doing everything possible in that direction.

The Chairman also suggested the use of dead bacterial bodies, but as I explained before, it is very difficult to destroy the spores, without killing the toxines, and after all one must remember that the great factors are the toxines.

I have referred to the cost of production which the Chairman brought forward. I am not prepared to say exactly what the costs are in the preparation of liquid vaccine, but at present we are selling it for 3d. a dose, not because it is a fair estimate of the cost, but simply because this vaccine is gradually being introduced to take the place of powder vaccine, and, we consider it is good policy not to make any difference in the price at present. The actual cost, however, must be extremely low.

The natural aggressin vaccine is more expensive than the powder, but a very much better vaccine than any of the others.

We intend to use the natural aggressin, but only in cases where infection is very bad or where breakdowns in immunity have occurred after the use of the other vaccine: or in cases where farmers specially ask for the more expensive vaccine, and are prepared to pay for it. The sale price should be at least 6d. per dose and even then we would probably lose on it. It is extremely expensive, because calves are employed, and at the most one can only get about five litres out of each calf. In the Union calves are very expensive.

A. SPECIFIC ANIMAL DISEASES.

(8) Gallamziekte.

Dr. P. R. VILJOEN (Sub-Director of Veterinary Education and Research, Pretoria): When I was asked to introduce the subject of gallamsiekte I was not particularly keen, for the simple reason it is such an enormous one that it is extremely difficult in the time at my disposal to give a brief outline of the disease, and the enormous difficulties which were encountered before the cause was finally discovered. I shall, therefore, try to give you as short an outline of our knowledge of this disease as it is possible to do.

Gallamziekte has been known for many years in South Africa. At first it only occurred in localised areas, and in sporadic form. Like so many other diseases in Africa it was considerably overshadowed by many of the more important problems in the country. To give you an example of this: Wireworm in sheep has been a serious problem in the Union for years, and now an effective remedy has been found to eradicate the worm from the infected sheep. After the remedy had been used for some time farmers were still losing sheep from parasitic infection.

Then they began to doubt whether the remedy was really effective, and it was shown that another parasite—the nodular worm—was the cause of this severe mortality in sheep, which shows that one disease, can be entirely overshadowed by another. Gallamziekte was also masked by other more important diseases.

The disease occurs only in certain parts of Africa, *i.e.*, in the drier climates, and in these areas it occurs under certain climatic conditions. The cause of the disease was unknown until about 1919. Many members of the research staff have been working at it for the last ten years and their efforts were not crowned with any great success until about two or three years ago.

The discovery of the cause of this disease is one of the most remarkable scientific discoveries of recent years. The disease was found to be in the nature of a ptomaine poisoning, which as you know, occurs in human beings after the eating of canned meat or sausages that have become infected with *bacillus botulinus*. That will immediately raise the question how cattle which are not carnivorous could become infected, could contract the disease through ingesting meat, and it is here where further remarkable discoveries were made by Sir A. Theiler and his co-workers.

The disease is set up by a very powerful toxin, developed in decomposing animal matter. Since we know that cattle do not normally pick up decomposing animal matter of any kind, they are not carnivorous animals, some other explanation must be offered. It is explained by the development of the so-called pica, or abnormal craving which occurs in cattle in certain areas. So you will see there are two main factors to be considered in the causation of this, up to quite recently, most baffling disease, the one is pica and the second is the toxin.

Now, the so-called pica is present in many parts of the Union, probably in other parts of Africa, and may be up here to a certain extent. It is particularly marked in areas where lamsiekte occurs. It has been definitely shown by extensive experiments, that it is entirely due to the lack or deficiency of phosphorus in the pasture, this deficiency of phosphorus being more marked in certain seasons, or at certain times of the year. It is especially bad in times of drought, and after wilting of grass has taken place, and as you will see later, the incidence of lamsiekte coincides with this variation in the phosphorus contents of the pasture; now the second important factor is the toxin which is produced by certain bacteria present in decomposing carcases, in the same way as *B. botulinus* produces the toxin in decomposing meat and sausages. The particular bacterium responsible for the toxin production has, I am sorry to say, not yet been isolated: we have come down to two or three organisms in a mixed culture, but further than that we cannot get as yet. It may be possible naturally that symbiosis is necessary in this case, and that the specific organism really requires the presence of others before it can develop its powerful toxin.

The toxin is easily obtained by simply infecting an anærobic culture medium with infected material or with previous cultures. It is an extraordinarily powerful toxin, one ten-thousandth part of a c.c. per kilogramme body weight being sufficient to kill cattle. Toxin production is most active during summer months, and at times when the rainfall is not too heavy. The infection of the carcase may take place before or after the death of the animal, that is, the organisms may be present in the intestinal tract of the animal, and not cause any disturbance whatever until, when the animal is dead and the carcase commences to putrefy, they invade the body with putrefactive bacteria, and produce a toxin. On the other hand, they may only get into the carcase after the death of a particular animal, and in this case it is a question of soil infection.

In lamsiekte areas all carcases are infected at certain times of the year, that is to say, it is not necessary for a carcase in which toxin is produced to be from a lamsiekte animal. A perfectly healthy animal can be slaughtered and allowed to putrefy in the veld, when the same toxin production will take place. Similarly in wild animals that die in the veld the toxin appears after putrefaction.

As regards the distribution of the organisms concerned, it would appear that they are only found in certain parts of South Africa, so that even if pica were present in many parts, or all over the country, it does not necessarily mean that lamsiekte will be contracted there by cattle. How far or how widely they are distributed it is not possible to say, as yet.

With regard to the animals affected, I might mention that in practice, cattle are the only ones that suffer from the disease, although, experimentally nearly all domestic animals can be killed by injection of the toxin. The reason for this is quite a simple one, namely, that cattle are the only animals which pick up rotten bones or other parts of the animal material. You are all aware that it is an extremely rare occurrence for sheep, goats, or horses, to pick up any bones or similar material.

The incubation period of the disease varies enormously from 24 hours to 14 days, depending on the potency and the amount of toxin picked up by the animal. From this you will realise, any animal may be killed within a very short period by injection of a large amount of toxin.

At the request of our Chairman, I shall run very briefly through the symptomatology and P.M. appearances of the disease, for the benefit of Delegates who have not met with cases of lamsiekte. The symptoms of the disease, as the name indicates, consist of progressive weakness or paralysis of the muscular system. Usually three forms of lamsiekte are recognised, namely, peracute acute and sub-acute, these, as you will understand resulting simply from the difference in the severity of the disease, that is, on the amount or the potency of the toxin ingested. In the early stages, the animal isolates itself from the remainder of the herd, walks slightly stiffly and is inclined to lie down; it seems to get tired. These symptoms develop very quickly, the animal gradually gets weaker, shows a characteristic stiff gait which is rather difficult to describe and very often paralysis of the tongue and pharynx occur, in which case the tongue hangs loosely in the mouth and profuse salivation takes place; in some cases, it is impossible for the animal to swallow any food, and bits of grass, etc., will be found inside the cheeks. In the more sub-acute cases the animal goes down and cannot get up, and may remain in that condition for several days, a week or a fortnight or more. In the acute cases the animal goes down within 48 hours, and may remain down for another day or two, when death takes place.

The mortality is extremely high, very few animals recovering from the acute disease, and no immunity results from an attack of the disease. An animal that has once had an attack during the year or if not during the following year, will contract the disease again.

The post-mortem appearances are not characteristic by any means, in fact, one very often confirms the diagnosis by the absence of any gross post-mortem lesions. The usual changes to be found are slight gastro-enteritis, muco-enteritis, and some congestion of the internal organs; further than that nothing is to be seen. I might mention here that no fever is ever exhibited by the sick animal.

With regard to the control of the disease, I may mention that our methods have been extremely successful during the past few years. Where formerly farming with cattle was quite impossible, people to-day have quite large herds of cattle, and their losses have been brought down from 30% to 40% to, perhaps, 5% or lower. The methods of control briefly are as follows: first, to clean the farm of all bone or carcase material, and to keep it clean; this naturally is rather a difficult proposition, and at first it really sounded quite impossible, but it has been shown that by a systematic method of picking up bones and other material from the veld, it is possible to get a farm practically free from all such material. As you are aware in this country—I am not so sure of the eastern part of Africa—in South Africa the method of disposal of carcases has always been simply to drag the dead animal away from the homestead, and to leave it on the veld until quite decomposed, and it finally disappears. That system is a most wicked one because many diseases are conveyed by material lying in the veld; I need only mention anthrax and black-quarter, apart from lamsiekte. It has been rather difficult to teach our farmers to change their methods of farming, and in future to bury or burn the carcases of all animals that die on the farms, but as soon as they realised that this method was giving satisfactory results, in so far as lamsiekte can be controlled, they began to act on our advice, and in many parts of the country farms can be considered practically clean to-day. Now, if one could ensure that there is no carcase material on the farm, no further steps need be taken to control the disease, but as you will realise it is an extremely difficult matter—only one, two or three ounces of bone material is sometimes necessary to kill a big animal, and infected material is often provided by small wild animals that die on the veld. Only recently an outbreak of lamsiekte occurred on one of our own experimental farms, where, I may say, the system of clearing up of all carcase material had been carried out for some time, and for all practical purposes this farm was supposed to have been quite clean of all bone material. I personally went down there to investigate and after making a few enquiries, I found that locust poison, an arsenical preparation, had been used on the farm to kill large swarms of locusts that passed through. As a result of this small wild animals, which we call meercats, died from arsenical poisoning after having eaten some of the dead locusts and there is no doubt that the cases of lamsiekte were due to ingestion of the carcase material of these meercats. In order to get over this difficulty and to make assurance doubly sure, we recommend the feeding of bonemeal, or rather to supply phosphates to cattle on those areas, to make good for the deficiency in the pasture. You will realise that if either the toxic bones, or the pica were taken away, no lamsiekte could develop, so that by a supply of phosphates, pica should disappear and cases of lamsiekte would no longer occur. In extensive experimentation it has been found that the remedy originally recommended—sterilised bone meal, is still the most economic and the best way of supplying phosphorus. I may say that any phosphorus compound, sodium phosphate, or phosphoric acid, will have exactly the same effect; when, after feeding animals on them for a few days or a week, the pica disappears and such animals do not pick up any material in the veld. We recommend a supply of three ounces of sterilised bone meal per animal per day. This on the surface, would appear to be rather an expensive method, but ways and means have been found to lessen the expense. Animals, as I mentioned before, have bad craving only during certain

times of the year and, therefore, economy can be effected by feeding bone meal only during that time; moreover, only a certain number of animals in a herd will show this marked craving and by taking these out and supplying bone meal to them only further economy can be effected. The cravers are picked out by simply offering the cattle putrid bones in troughs and those that take these bones are then picked out and bone meal is supplied to them, while the others, which show no desire to eat the putrid bones are left alone. In that way a great deal of economy may be effected.

Now, quite apart from lamsiekte, gentlemen, it has been shown very clearly and convincingly that our animals in certain parts of South Africa require more phosphorus in their diet. Animals that receive a regular supply of bone meal develop much more quickly than those that do not and they improve in condition very rapidly; it is, therefore, an excellent way of fattening cattle for the butcher. Unfortunately, I had no idea I would be asked to speak on the subject, otherwise I might have brought along some very convincing charts. We can show in curves, the extraordinary increase in weight shown by animals fed on bone meal compared with controls which have received no bone meal; in fact, in certain parts of South Africa—dry parts which our Chairman knows very well—animals get very poor in condition during the winter months owing to the lack of good grazing, but even in those parts I know the farmers are able to keep their animals in good condition by supplying them with bone meal. Many of our farmers to-day feed the bone meal purely from the fattening and development point of view, quite apart from lamsiekte.

I have already mentioned to you that no immunity develops after an attack of lamsiekte. Extensive experiments were made to discover a method of immunisation by injection of the toxin, but the results were entirely negative; no lasting immunity could be set up in animals by the use of the toxin. These results correspond with the observations in the field that no immunity develops, that animals are actually more susceptible after having passed through one attack of the disease.

The Chairman, remarking on the value of Dr. Viljoen's remarks said, it is not a problem which now deeply affects Eastern Africa, but at any time it might be one. He mentioned the different areas in which gallamsiekte was known and among them the Western Transvaal and the Grahamstown districts. He also mentioned that there is another disease, called by some "*imapunga*" and he wondered if there is any relation between the two diseases. It is possible that several diseases have been grouped under the name of gallamsiekte.

Although Dr. Viljoen says that goats are not inclined to pick up bones in his experience, goats are more inclined to do so than other animals.

He asked if Dr. Viljoen could give the approximate cost of bone meal, either per daily ration, or per 100 lb.?

Mr. H. E. Hornby: Are figures now available to show what has been the decrease in the mortality from lamsiekte on the experimental farm at Armoedsvlakte?

Are farmers themselves convinced of the efficacy of the remedial measures recommended and giving them a fair trial?

Mr. F. J. McCall: Has anything been done to ascertain the susceptibility of dogs, hyenas, or other wild animals to this ptomaine poisoning?

Mr. W. Kennedy: In discussing the various ways in which economy might be effected in the administration of bone meal Dr. Viljoen said that on affected farms they picked out the animals affected with pica by placing bones in troughs and ascertaining which cattle showed a desire to eat those bones. It struck me that the same result might be obtained by placing bone meal in troughs in the kraals and the cattle which do not possess the craving would leave the bone meal alone. The animals which had the craving would eat it and this might save some trouble in selecting animals requiring treatment.

The Chairman: Was there an outbreak of gallamsiekte in Tanganyika?

Mr. F. J. McCall: There was one reported by a veterinary officer, but we heard no more of it.

Mr. U. F. Richardson: There is in Uganda a disease named "*kamenia*" which very closely resembles lamsiekte in symptoms, the native custom is to remove their cattle and they state the disease then stops; it is possible they moved out of the area infected by the bones of their dead cattle.

Dr. P. R. Viljoen: With regard to the Chairman's questions—I am afraid we have no further information regarding the condition known as "*imapunga*." You are probably aware that heartwater has been suspected in many of these cases and even anthrax, but up to the present it is not at all clear what the condition is.

With regard to pica in goats, I must say that in South Africa it is an extremely rare thing for any goat to pick up or chew a piece of bone; they do so occasionally and in the bad lamsiekte areas occasional cases of the disease are seen in goats. The occurrence of the disease in goats is so rare that no notice need be taken of it.

I am very much afraid I have completely forgotten what the cost of bone meal is in the Union at present.

Re Mr. Hornby's questions. I would point out that the mortality from lamsiekte on the experimental station decreased from about 30% to 40% in 1914 to not more than 3% or 4% in 1919-1920, after these measures had been applied to the farm.

Figures are not available regarding the effects of bone meal feeding on the incidence of lamsiekte on private farms. I quite agree it would be extremely interesting to get further details in this connection. It is true that some farmers are convinced of the efficacy of these methods, but not all. Everywhere in the world, I think you will find very careful farmers, who would continue to clean their farms of all possible contamination and at the same time keep feeding bone meal, whereas there are others who are always inclined to slacken off and very often get dissatisfied and begin to doubt the efficacy of the measures recommended. Bone meal feeding as I mentioned earlier has been tried many years ago for this disease, some farmers used it fairly regularly and also the late Dr. Hutcheon of the Cape and Mr. Borthwick recommended its use in cattle, but they had no idea of the true nature of lamsiekte in those days. Why bone meal feeding failed is simply because it was not fed regularly, as it should be, to be effective. Unless it is done very systematically animals will develop craving and if no cleaning up of the farms themselves had been carried out, then they would pick up infected material and so contract the disease. We recommend both measures to be taken, i.e., the farm to be cleaned, because it is so difficult to be quite certain of the results and with bone meal feeding also carried out to make sure that no further cases occur.

Mr. McCall raised the question of susceptibility of dogs and other animals, we have experimented with dogs and found them to be very resistant to the toxin, in fact, most carnivorous animals seem to have a natural immunity against this toxin.

As regards Mr. Kennedy's question: Bone meal is not used in the pica tests because if you put a sack of bone meal in front of half a dozen or a dozen cattle they might go on eating until they have finished the lot; at first animals show a dislike for bone meal, but after a week or two's feeding they get quite mad after bone meal. The bones used in the test are rather unpleasant, they are partly putrid, but sterilised to prevent infection of the animal. These are not so readily eaten: if animals get sufficient fresh, clean bones they certainly will not touch the putrid ones; it is only as a last resort to satisfy their craving that they pick them up.

I was interested to hear from Mr. Richardson that there are actually suspected cases of the disease in Uganda and I should very much like to hear from him what the symptoms are and if the climatic and other conditions are likely to be favourable for the development of the disease. As I mentioned, there are only certain definite regions and certain climatic conditions in which the disease can be contracted. The indications are that lamsiekte infection can only thrive in certain definite climatic and soil conditions, so that it is unlikely that the disease will spread all over the country, excepting on to farms where the conditions are suitable. Mention was made of moving animals to other parts and that the disease stopped, this certainly makes one suspicous of lamsiekte, because that is one of the old measures we recommended for controlling the disease. Before we knew what its true nature was we recommended this and farmers themselves knew that after changing the pasture the disease very often stopped quite suddenly.

Mr. U. F. Richardson: In Uganda this disease only occurs in October, about the beginning of our short rains. Symptoms are dropping behind the herd, followed by general paralysis, there is a depraved appetite; I do not know if they have any special preference for bones. It occurs when the rainfall is not heavy.

A. SPECIFIC ANIMAL DISEASES.

(9) Infectious Bovine Abortion.

Mr. W. Kearney (Assistant Chief Veterinary Research Officer, Kenya Colony): Infectious bovine abortion is undoubtedly a complaint of far less economic importance at the present time in Eastern Africa, than the diseases you have been dealing with up to now. Nevertheless, it should, in my opinion, receive your most earnest attention at this Conference, in view of its possible seriousness arising before another Pan-African Meeting of Veterinarians takes place.

We know that in countries like Southern Rhodesia and South Africa, where the more serious epizootics, such as rinderpest, are absent, infectious abortion plays no small part in veterinary activities and it is not unreasonable to anticipate that a similar state of affairs may arise in our local territories before long.

From available statistics the complaint was first definitely diagnosed in this Colony in 1913. Whether it existed before that time I am unable to say, but it would not be altogether wrong to assume that it did. How and from where the complaint was introduced I am also unable to say.

Since 1913, we have found cases present on a large number of European farms and we can assume with comparative certainty that our native reserves are also implicated. The disease can, therefore, be said to be widespread in Kenya at the present moment.

That the complaint in Kenya is the specific abortion caused by the *bacillus* of *Bang* has been proved beyond doubt by the application of comparative tests with the causal organism of this country and strains sent us from South Africa and England through Sir Stewart Stockman.

So far we have been unable to collect sufficient data to give dependable figures as to the losses which have occurred from the complaint in the Colony, but during the past 12 months we have diagnosed some forty positive cases out of 130 samples of sera submitted for examination. The positive cases were not confined to a few infected farms in the Rift Valley, for example, for they came from farms as widely apart as Kitale on the Uasin Gishu Plateau and Nyeri near Mount Kenya.

The method of diagnosis employed by us at Kabete, is the ordinary agglutination test used in other countries. The technique is simple and the results are reliable. We give a positive return when agglutination is complete at 1 in 100 dilution. Where only a partial agglutination occurs at this dilution we give a doubtful return and ask for more serum.

It might be of interest to some of you, who have not had the time or opportunity to keep in touch with recent research work, to give you a few of the more important facts concerning the complaint which has been elucidated in recent times.

(i) The commonest mode of infection is per os.

(ii) The bull is of less importance as a factor in its transmission than was previously thought, though he cannot be eliminated altogether.

(iii) The causal bacillus remains dormant for indefinite periods in the udders of cows which have had an attack of the disease and recovered and they are potential sources of infection for that reason.

(iv) The *bacillus of Bang* and the *bacillus melitensis* of Malta Fever have some characteristics in common.

(v) Immunity can be conferred in non-pregnant animals by the artificial inoculation of living cultures of the bacillus.

We have much to encourage us in our efforts to control and eradicate infectious abortion.

First of all, we must consider the precautions applicable to maintain clean herds free of the disease. The most likely agent to carry the infection to a clean herd is an infected pregnant cow, or a cow which has aborted and whose udder harbours the bacillus. We can protect the healthy herd against animals of this kind by the use of the agglutination test. No bovine should be allowed into the clean herd until it has been subjected to the test. A few week's quarantine is essential before applying the test, as antibodies are not usually present until that time, after abortion occurs.

What action should be taken with infected herds is a more difficult problem. Choice may be made of two methods which to my mind would give best results.

(1) Cleaning the herd by using the agglutination test to determine the affected animals.

(2) The application of artificial immunisation.

The first method would be impracticable to apply in a large scale in a country such as this.

The artificial immunisation method with living cultures appears to be satisfactory where we are sure we are dealing with non-pregnant animals, but under conditions pertaining here this is almost impossible.

Mr. Bevan, in Rhodesia, however, claims to have an efficacious vaccine, which he can apply with safety to pregnant beasts as well as non-pregnant beasts. If the results are as satisfactory as Bevan claims, I think this Conference might be justified in approaching him on the matter.

I do not consider it wise to discuss the possible relationship which is said to exist between this complaint and Malta Fever, until more work has been carried out.

Mr. H. E. Hornby: The question of contagious abortion in Central Africa centres round the question—has it existed in native herds from times immemorial, *i.e.*, is the disease indigenous to Central Africa and very mild in consequence?

I myself am convinced that the disease exists throughout Central Africa. In North-eastern Rhodesia it is unlikely that it was introduced by the few bulls imported from England, yet there contagious abortion, as confirmed by the agglutination test, certainly exists. Among native-owned herds abortions are frequent, while in European-owned herds of native and grade cattle, the incidence of abortion on the whole is small, but occasionally the numbers increase until they assume the proportions of an outbreak. Nevertheless the disease is not a very serious one.

Mr. J. T. C. Bradshaw: There is no doubt that, as far as this country is concerned, the disease is more prevalent in European-owned herds than anyone at first thought it to be, and quite recently one owner of stock reported that his losses in one season were 15% of calves due to premature births and naturally he wishes to be protected against such losses in the future. The point then arises as regards vaccination in herds where the losses go up to, say, 20% of calves in a year.

Mr. W. M. Power: This disease is fairly widespread throughout South Africa, but so far as Natal is concerned, it occurs much more amongst European-owned than in native herds. In the reserves very little is known to exist and in this respect I might mention that these areas are under supervision owing to East Coast Fever.

The disease has been imported from England and doubtless from other countries.

Infectious abortion was only diagnosed positively, I think, about 1910, though it was suspected to exist before this.

It is more prevalent amongst the better bred herds than amongst the common cattle, but it is impossible to say definitely to what extent a disease like this exists.

I have seen a good many outbreaks and although it is a very serious disease, the losses are not usually as heavy as in England. Cases where heavy losses take place are mostly amongst well-bred dairy herds closely housed and kept under somewhat similar conditions as cattle are kept in England, though I am aware that serious losses have occurred amongst veld cattle.

I was glad to hear that Mr. Kearney appreciates the difficulty of dealing with this disease by the agglutination method, that is, by picking out infected animals and running two herds. We tried that in Natal some years ago, after the disease first broke out and we found that it was impracticable. I consider it is almost impossible for farmers to run two herds, infected and non-infected. They would require two sets of farm buildings and there may be exceptional cases where it may be done, but on the whole I am sure it cannot: it is not now a scheduled disease in the Union.

At first when it was diagnosed we considered we were justified in imposing restrictions on cattle movements. That seemed all right while we had a limited number of outbreaks to deal with, but as time went on and the disease was diagnosed in fairly widespread areas all over the country there was a general outcry against this. A definite quarantine period could not be fixed and there was no prospect of being able to raise the quarantine within a reasonable time. As cattle owners began to realise that such restrictions were being imposed, we felt that many were not reporting the disease and that really our precautions in regard to the farms where we knew it existed had little effect on the spread of the disease. If a farmer did not want to report an outbreak he did not do so and it is very doubtful if he was ever found out. He could move his cattle about the country and dispose of them from infected herds, whilst the man who reported an outbreak and asked for a test was shut down indefinitely. The whole matter was then reconsidered and as a result it was decided to withdraw the restrictions.

The demand to have non-pregnant animals inoculated, is increasing in Natal.

I am very sorry, Mr. Chairman, that Rhodesia is not represented here as information on the present position of the disease in that territory would be interesting.

We came in for some adverse criticism for removing the restrictions against this disease and it was suggested that the question of the eradication of the disease should have been faced. Consequently, I should like information on the results obtained by maintaining restrictions as is done in Rhodesia.

Mr. H. E. Hornby: Mr. Power seems to suggest that the disease was introduced into South Africa from Europe and the reason why the native-owned cattle do not suffer so much as European-owned is because they are not yet as widely infected. May I suggest the alternative theory that native cattle are largely immune owing to long contact with the disease?

Mr. W. M. Power: I have seen the native cattle act exactly the same as European, when exposed to infection. I think the comparative freedom of the native cattle from this disease is due to the fact that they have not been exposed to infection to the same extent as the cattle of Europeans.

Major W. Kennedy: I should be glad to know if the percentage of barren cows in the native territories of the Union is high or low.

Mr. W. M. Power: I should say that the percentage is low.

Mr. F. J. McCall: Contagious abortion amongst native cattle in Tanganyika is not regarded as a problem, neither is its presence recognised by the natives. In view, however, of the remarks just made by Delegates from surrounding territories, we may, I think, safely assume that it does exist. Abortions do occur and those which are not recognised as due to accidental causes, are usually attributed to rinderpest; many barren cows are encountered and the history usually elicited by enquiries on the spot is that subsequent to abortion (the result of a severe attack of rinderpest), the animal failed to again become pregnant.

The position, therefore, is that at present in view of its comparative unimportance, no official cognisance is taken of the disease and no action or inoculation is contemplated.

Dr. P. R. Viljoen: As Mr. Power has remarked, contagious abortion is extremely prevalent in the Union of South Africa and indeed is of the greatest economic importance.

Before discussing the administrative control of a disease of this kind, we should be quite clear as to how we stand in connection with our knowledge of the causal organism itself. It has been remarked by Mr. Kearney, and quite correctly, that the most serious source of infection and spread of the disease is the aborting cow, *i.e.*, the uterine discharge, the foetal membranes, etc., which are derived from such an animal.

Now at this stage it might be necessary to review very briefly our knowledge of the organism inside the animal as well as in the outside world. In the pregnant cow we know that the organism multiplies in the pregnant uterus and that the udder is also infected with the organisms. From such an animal, therefore, there are two sources of infection that may be considered, the foetal membranes and uterine discharges. In such an animal we know that after a certain period the discharges from the uterus stop completely and one may assume that when that happens the spread of infection from this source also ceases to a very great extent. Such an animal then would discharge the organisms mostly through its milk supply. Now to me it seems that this source of infection cannot be considered of very great importance on the farm, for the simple reason that cows do not usually excrete any milk whilst running in the pasture. To put it more plainly, no milk escapes from the udder whilst the animal is out at pasture.

Now, taking the non-pregnant animal, we know that non-pregnant heifers and oxen may become infected, although only temporarily; in other words, the organism must multiply somewhere in the body. As yet, we do not know where this multiplication takes place. As I mentioned before, the organism has for its seat of multiplication the pregnant uterus and the udder. In the non-pregnant heifer or cow, and the ox, these conditions for the growth of the organisms are not available. It appears to me, therefore, of considerable importance that further work should be done, in order to find out exactly where else in the body the organism may take a hold and multiply. You will remember that in work that has been done with the disease so far the organisms have been isolated practically from nowhere else except in the regions indicated by me.

We will now review our knowledge in connection with the biology of the organism outside the animal body. We have had it recorded and it is generally accepted that the contagious abortion bacilli are not very resistant, *i.e.*, when exposed to adverse atmospheric conditions they succumb very quickly and yet, on the other hand, we know that farms can remain infected with the disease for long periods. Here again, therefore, the urgent necessity for further research work will be recognised.

As regards the eradication of the disease, we are immediately faced again with the fact that we do not know what happens to the organism outside the body and we cannot, therefore, hope to eradicate the disease completely. Until we know exactly how these organisms live in the veld, whether they multiply and how long they exist it is quite impossible to express any opinion on the possibility of eradicating the disease completely.

In South Africa some attempts have been made to control the disease by quarantine measures. It was soon realised, however, that the infection was far more widespread than one thought at first and that for this reason practically the whole country would have to be put under quarantine. I firmly believe that there are few parts of South Africa which are quite free from the disease. I quite agree that it would be a most desirable thing if one could keep infection away from clean

farms, but it is an extremely difficult matter. If the farmer is careful not to bring any strange animals on to his farm which have not been definitely proved to be free from the disease then it may be possible, but in South Africa at any rate there is no restriction with regard to the sale of infected animals, the people who bring animals to public sales, naturally, do not state whether the animals are free from the disease or not. There is no law at present to demand such a statement from anybody, but I personally advise farmers not to purchase any animals outright, but to have their sera submitted to the laboratory test first.

The infected farms from the point of view of eradication, present grave difficulties, as was mentioned by Mr. Kearney and Mr. Power. We have made several attempts to clean the farms by isolating the infected animals, but for some reason or other fresh infection always crops up again.

I remember one farm where a clean herd is kept in one camp where no abortion has occurred for some months and yet an occasional infected animal is still being picked out by the serological test, so that there is some other factor coming in that we do not know of; it is for this reason that I have laid emphasis on the necessity of studying the viability of the organism outside the body.

In my opinion, the only way of dealing with infected farms is by vaccination with live vaccine. First of all, by injecting the vaccine into non-pregnant animals, immunity is set up and subsequent abortion is prevented. Moreover, by carrying out the inoculation in a systematic manner, *i.e.*, by vaccinating all non-pregnant cows and heifers, when such animals are available on the farm, the whole herd can be vaccinated within a year or so and practically all loss from abortion can be stopped in that way. Unless this were done, the infection would become widespread from the repeated abortions that take place. By vaccinating animals the actual abortions are reduced from 90% to 5%. It is true that by the use of live vaccine the animals are actually infected with the disease, but no harm can result if they are not pregnant at the time of inoculation. Moreover, it is even doubtful whether the disease can become properly established in non-pregnant animals.

I have been asked by certain farmers whether it would be right to offer vaccinated animals for public sale, knowing as they did that these animals must be infected. The answer to that is again a very simple one. A farmer will sell animals which he may or may not know to be infected naturally with the disease. The infected animals are almost certain to spread the infection to the other farm. The chances of infection being spread by vaccinated animals are extremely small, because such animals are not likely to abort, so that even a conscientious man should have no scruples about selling.

Mention has been made of Mr. Bevan's vaccine. Unfortunately, we are not in a position to discuss it. I may only say that dead vaccines have been tried extensively in Great Britain, Germany and other countries, and they have proved failures. We, in South Africa, have not tried these, because we feel it would be foolish not to take notice of the results obtained by other workers and to repeat their experiments at the expense of public money. Another point which I wished to mention is that by vaccinating animals on infected farms, not only are the abortions reduced from 90% to 5%, but the sterility which frequently results from abortion is also reduced so that in the end the immunisation by live vaccine is undoubtedly the better method.

In the Union we have been carrying out research work into the identity or otherwise of the Malta Fever and contagious abortion organisms and with the material we have had available I must say at once that we were not able to distinguish between these two organisms. One cannot see any difference whatever, either morphologically, or in serological tests.

I believe Mr. Bevan, of Rhodesia, has recently drawn attention to the similarity of the two diseases and to the possible danger of human beings becoming infected from the milk of contagious abortion cows. I do not know any reason for considering these two diseases to be identical in any way. In Great Britain, where they had such extensive outbreaks of abortion in cattle whose milk is used by European people all over the country, Malta Fever is practically unknown. In this country also milk from cows infected with contagious abortion is used very extensively and yet one never hears of any ill-effects ensuing.

I may mention that these two organisms can be distinguished by other experimental methods, animal inoculation, because they differ in their pathogenicity. We have tried our strain of Malta Fever in monkeys, but apparently this strain has lost its pathogenicity. Further work, however, will be done in this direction.

Major Paul. Tissie: Contagious abortion has not been diagnosed in Madagascar. There are very few European-owned milch cows. Many individuals have a cow or two for their own milk supply. Native cows are not stabled. As regards grade cows, natives usually possess one or two and each is stabled separately.

THE CHAIRMAN: I think the concensus of opinion is that contagious abortion is widespread and will probably be found in the places which it is not yet known, if a thorough search be made. I assume that the observations up to now have been limited.

I feel that we also should be agreed in supporting the action of the Union Government in removing this disease from the schedule of contagious diseases.

The conditions under which it exists in Africa, render it difficult to apply legislation. As was pointed out to you, the man who is honest is penalised, but the man who is dishonest, or who is ignorant gains the benefit. A Government can hardly support a policy of this nature. We are then faced with the fact that contagious abortion is with us to a very great degree. We have the knowledge that, if rendered capable of application, the vaccination of the stock is beneficial in controlling the losses from this disease. The farmers have that means of application and understand its significance, but the native owners to-day have no instruction in the method and it lies with the different Governments to decide whether the losses from the disease in these native reserves are of sufficient magnitude and value to justify the introduction of inoculation of the herds as a preventative. The day of eradication of contagious abortion is far distant, but the day of controlling is certainly quite near as facilities are forthcoming to the veterinary staffs for the education of the native owners and for the administration to prove to them that science has found a means of protection against the disease.

We have only to notice, as has already been mentioned by Mr. Kennedy and Mr. McCall, the enormous numbers of barren cows that ought to be earning their keep by breeding, but are rendered non-productive in very many areas by this disease. If that could be eliminated or reduced, as we believe it can I personally think that a beginning, naturally, in a small way, towards the inoculation of females would justify the expenditure.

On the subject of Malta Fever we must agree with Dr. Viljoen that however identical the organisms may appear morphologically and serologically, there is a difference in pathogenicity. Man does not appear to get contagious abortion: goats which are the incriminated animals for Malta Fever, do not suffer from contagious abortion. The diagnosis of contagious abortion made only a few days ago at Entebbe showed that the agglutinating power of the serum on *B. Melitensis* and on the bacillus of contagious abortion was identical.

If we are agreed that something in the way of an organised campaign against the losses from contagious abortion can be carried out by vaccination, we must have information as to the ability of the various institutions to produce vaccine on a large scale and the price at which it can be issued.

I would like to ask Mr. Kearney or any of the other gentlemen present what they would consider the best, simplest and most practical method for collecting blood in the field for despatching to the pathological stations for testing.

Mr. J. T. C. BRADSHAW: Has anybody any information re abortion in mares? Many cases have occurred in this country recently. Reports of abortions amongst thoroughbred mares are frequent, occurring in different parts of the country: owing to long distances and lack of suitable material to work upon, no definite diagnosis has yet been made, but the history of the outbreaks, where many mares are implicated during certain seasons in the same locality, point to a condition which may well be of an infectious nature.

Dr. P. R. VILJOEN: We have no experience in the Union, nor has it, as far as we know, occurred in mares to any extent.

Our method of collection of blood samples is a very simple one. We send out small bottles, three to four ounces in size, to farmers wishing to send samples and ask them to fill the bottles up to the shoulder with blood from the jugular and forward it in the bottles without drawing off the serum. At the laboratory we let the bottles stand and draw the serum off afterwards. The serum is sometimes discoloured with hæmolysed blood, but this does not present a real practical difficulty because one can still use the serum for the test. The serum would be very much better if not discoloured, but it is quite out of the question to ask the farmers to draw off the serum.

THE CHAIRMAN: The difficulty I foresee is that farmers may not be able to extract blood from the jugular. The original method adopted at Kabete was to send out vaccine pipettes and ask the farmers to return these filled with blood drawn from the ear and sealed with sealing wax at each end. It was comparatively easy for the farmer to take five or six pipettes of blood from the same animal.

Mr. W. KEARNEY: I might say that we have given up the pipette system at Kabete, for the reason that the pipettes were not always properly sealed and serum was not always present on arrival at the laboratory and we have now introduced the system outlined by Dr. Viljoen. We have no difficulty in getting the requisite amount of serum from the bottles on receipt.

Captain R. H. KNOWLES (R.A.V.C.): Epizootic abortion has not been detected in the Sudan.

Mr. W. Kearney: From the discussion that has taken place there is no doubt that the subject of infectious abortion is a very serious one, in that its extent is very wide in the parts of Africa from which the Delegates to this Conference have come. The difficulties of applying measures to suppress or eradicate the disease are very great in countries where there are large native territories. In South Africa where the veterinary supervision is closer than that obtaining elsewhere, then probably the lines suggested by Dr. Viljoen might, and will, have a beneficial effect. I cannot, however, see how these methods can be put into operation in large native territories.

The difficulties of controlling the disease in native areas are enormous, for the simple reason that to try and introduce vaccination methods would, I am afraid, be out of the question at the present moment. We are left, therefore, in the position that we can only apply remedies in closely supervised countries. I might say that whilst I was home in England, last year, I had the pleasure of meeting Sir Stewart Stockman, who gave me his ideas as to the position concerning the disease existing in England. He was extremely optimistic of beneficial results accruing from his activities. His vaccine—a living culture—he was supplying through the medium of veterinary surgeons. At first he met with some difficulty as veterinary surgeons in the main were afraid to use the vaccine. Latterly, however, sympathetic action has been taken by them and the vaccine is now supplied with very encouraging results. We have a letter from Sir Stewart Stockman, of January of this year, in which he writes:—

"The bacillus I am now making use of for the preparation of vaccine is, I believe, attenuated. The attenuation has been effected, however, mainly by growing it for many years entirely outside the bodies of animals with the assistance probably of change of media, etc.

"I am not in a position to say exactly to what my attenuated strains actually owe their attenuation, but you may take it that although attenuated, they cannot be considered harmless, in the sense that they will never produce abortion when administered to a pregnant animal. As a matter of fact, I doubt very much if you can get a bacillus quite incapable of producing abortion and yet capable of producing effective resistance. Even attenuated strains, however, do not always certainly produce abortion or effective resistance.

"There is a great deal of misunderstanding regarding the theory which underlays the method. It was based primarily on the following: If you inject virulent strains of the abortion bacillus by the hypodermic method and leave the animal empty for a couple of months you are not likely to infect it (in a manner which will cause it to abort, at least) and in most cases you endow it with considerable resistance against actual abortion. There are some animals, however, which appear, from constitutional reasons, to be very much less immunisable than others.

"We have found that in order to produce this resistance massive doses of artificial culture must be given. We give, as you probably know, 50 c.c. and we have spent a great deal of time in getting the bacillus to grow in massive cultures. You can see, of course, that 50 c.c. or even 100 c.c. of a poor culture might not be effective.

"I do not think you need worry about inoculating animals hypodermically with living cultures, especially with a somewhat attenuated form. Even if you did it hypodermically with the less attenuated strains and gave the animals two months before pregnancy you would not get a large number of abortions: probably not more than 5% if you came to reckon the inoculated animals by, say, 1,000.

"On no account would I advise you to use any kind of living culture in a clean herd, nor do I see any necessity for doing such a thing, which to me seems little short of lunacy.

"Having got the proper strain, you are still met with difficulties in getting the right medium in which it will produce massive cultures and further, you have the difficulty of a good bottling system, which is always great when using live bacilli.

"For culture media, we use neutral broth plus 1% of glycerine and 1% of sugar, taking care, of course, not to overheat the sugar. It is then grown in large conical flasks with wide bottoms so as not to produce too deep a layer of fluid. Each flask has about 250 to 300 c.c. and the depth should certainly not be more than half an inch. To get a massive culture they have to be incubated for a month at least.

"As regards the bottling: it is very difficult to tell you how to do this, although we have now got a good system. It is a matter, really, for demonstration, and if any of your men with knowledge of these things is at home, the method could be demonstrated at the laboratory. The plan is to bottle it direct from the culture flasks, allowing only filtered and sterile air to enter the flask to replace the vacuum caused by the fluid running out into the bottles. Air is filtered through a glass spiral containing sterile glycerine.

"I have been working for some time on a quicker method of attenuation and I think it possible that I have got results, but it is too soon, as yet, to discuss them."

I might add that we are following Sir Stewart Stockman's methods in the preparation of the vaccine at Kabete. We are not yet in a position to turn out vaccine in large quantities, since there are difficulties owing to shortage of laboratory apparatus.

In conclusion, I might summarize the discussion in the following words: We have a method of immunization which is undoubtedly satisfactory, but we still have the difficulty of applying this particularly in the native reserves.

Mr. Bradshaw asked if vaccination should be carried out in a farm where 15% of the animals had aborted. I should say, undoubtedly, yes.

Dr. P. R. Viljoen: We have been inoculating animals, that have aborted previously, with satisfactory results.

Mr. W. Kearney: A point that Dr. Viljoen mentioned also was the lack of knowledge as to the duration of the life of the bacillus outside the body. In reading an article by Cotton yesterday, I found that he stated the life of the bacillus is a fairly long one, but he did not give a definite length of time.

Another point which cropped up was the occurrence of contagious abortion in mares. Mr. Bradshaw made reference to the subject. We did find in this country a few years ago an outbreak of abortions which occurred in a large racing establishment and which clinically resembled contagious abortion of mares, but we were unable to isolate the *bacillus abortivo equinus*.

The Chairman: Mr. Kearney did not say anything about the cost of the production of the vaccine.

Mr. W. Kearney: The cost has not yet been worked out by us at Kabete.

Dr. P. R. Viljoen: We are selling the vaccine at S. 1 per dose. Our method is different from Sir Stewart Stockman's: it is perhaps more elaborate and involves more labour and expense and for those reasons it is expensive. We grow our organism on the surface of solid media. One reason for this is that we can see the organism growing and keep a check on outside infection whereas in the liquid medium it was difficult to see what organisms are growing. We simply wash off the growth from the surface of the media and make the vaccine as required. It is issued in a dose of 10 c.c.'s, which contains an enormous number of the bacilli. The growth is made on Sir Stewart Stockman's Potato-Agar Media.

Mr. W. M. Power: I suggest the Conference is justified in recommending vaccination in infected herds where considered desirable.

RESOLUTION.

Infectious Bovine Abortion.

This Conference recognises the value of using living culture vaccine in controlling this disease.

A. SPECIFIC ANIMAL DISEASES.

(10) Avian Diseases.

Mr. W. Kearney (Assistant Chief Veterinary Research Officer, Kenya Colony): The poultry industry in Kenya Colony is now beginning to assume importance and the type of bird marketed is of a good quality compared with that of a few years past.

The industry is not alone attracting the attention of the European settlers, but the native population is also beginning to realise the advantage of larger fowls and eggs.

There is a demand in Nairobi for eating eggs of English bred fowls at prices up to S. 2 per dozen as against half that price for eggs of native fowls.

Native fowls can be procured for about S. 1 each while English table birds are up to three times that price.

There is no doubt that the biggest obstacle to the successful raising of poultry in this country is the presence of contagious diseases and of by far the greatest importance is one which our Chairman named *Kikuyu Fowl Disease*.

We get in addition to this, tuberculosis, infectious sarcoma, diphtheria and other well-known conditions. Internal parasites, viz.: tapeworms and round worms also the air-sac mite are prevalent, while lice and external parasites are common.

One could, I think, with safety say that Kikuyu Fowl Disease claims up to 90% of the victims to disease in this Colony and in view of its serious nature and because of the absence of general information regarding it, I will describe the disease to you briefly.

Aetiology. The disease is caused by a small gram-negative bacillus of the dysentery group, which is found in the blood stream and internal organs after death. It is easy to isolate and it grows well on ordinary agar.

Birds susceptible. Domestic fowls and turkeys. Ducks and pigeons are immune.

Pathogenicity. The disease can be conveyed to susceptible birds by inoculating them subcutaneously with a small amount of the bacillary emulsion, or, by feeding the birds on material infected, either droppings of sick birds, or cultures of the bacillus.

The incubation period is about one week by feeding and from three to five days by inoculation.

Symptoms. Drowsiness, profuse diarrhœa, discolouration of the comb, followed by weakness, coma and death.

In some instances up to 100% of susceptible birds will succumb during an outbreak.

Pathological Changes. The gross changes are in the liver, which is markedly enlarged and friable; the spleen is also very swollen and there is a marked enteritis.

Control. Active immunisation can be effected artificially by the inoculation of a living culture of the bacillus. As far as our statistics go immunity is conferred for one year at least and is probably life-long.

I might say that the culture which we are using for immunisation purposes was isolated in 1917, at which time it was virulent. To-day it is attenuated and apparently fixed.

In view of the similarity of the symptoms and certain post-mortem lesions which this disease bears to that of fowl cholera, I would like to state that we have definitely proved that the causal agent of both diseases differ.

A point which may be of interest to the South African Delegates might be mentioned. A few years ago we tested the susceptibility of some South African fowls to Kikuyu fowl disease using as controls local fowls and we found that there was a marked degree of natural resistance on the part of the South African fowls to the disease.

Neither are imported English fowls as susceptible as the native fowls.

I do not think that any remarks need be made by me in connection with fowl diseases in general. We all know what they are and what precautions should be taken.

Mr. H. E. Hornby: Recurring epizooties of fatal diarrhœa occur among native fowls throughout all parts of South-central Africa, but whether more than one disease is involved has not, I think, been settled. I shall be glad to ascertain for Mr. Kearney whether the particular diarrhœa of fowls in my part of Tanganyika is true Kikuyu Fowl Disease.

Mr. F. J. McCall: I should like to draw the attention of the Delegates to a peculiar disease which affects imported fowls in Dar-es-Salaam. It is associated with progressive anæmia and muscular inco-ordination. One of the most typical symptoms is a peculiar jerking movement of the leg, the limb being carried sharply forward when the animal attempts to walk. The impression conveyed is that the extensor muscles take command and that the flexors are unable to operate. I am informed by my medical friends that a similar flicking of the foot is observed in certain human deficiency diseases. I think *pellagra* was mentioned. I have heard that a certain poisonous plant is capable of producing an analogous condition. Microscopical examination of the blood fails to reveal any abnormality apart from excessive anæmia.

Dr. P. R. Viljoen: We have many poultry diseases, mostly the well-known ones which have not come up for discussion this afternoon. In addition there are also a good many diseases which require investigation.

I may say that poultry until recently were not considered of any great economic importance and partly for this reason and partly because we had so many other big problems to settle in the country very little attention has been paid to poultry diseases. During the last few years, however, the poultry industry has developed enormously and at the present time I believe a Poultry Division, separate from the other Divisions of the Department of Agriculture, is being considered. This will show you what an important industry it has developed into.

We are not yet, however, free from our most important disease problems. There are still many of these diseases requiring investigation, but I am quite sure that we are in a position now to commence the study of poultry diseases as well. In fact, a start has already been made during the last few months. Material is being collected as far as we can in both Pretoria and Maritzburg Laboratories and I feel quite sure that when the Pan-African Conference meets in three years' time we shall be able to say a good deal more about diseases of poultry.

Mr. J. A. Griffiths: In Nyasaland we have sick fowls exhibiting symptoms of a disease similar to *Kikuyu disease*. The disease appears periodically in epizootic form and practically wipes out the fowls in the areas affected. In such cases we cannot get fowls and as people on out-stations depend to a large extent on fowls for food such a disease is of considerable importance.

Recently we have observed a similar disease to that described by Mr. McCall, *i.e.*, paralysis. Death takes place in about a week or ten days. This paralysis goes right through the flock. It is contagious, apparently, and the birds all die.

There is also the disease *aspergillosis* which appears in epizootic form among ducks in our lake districts, causing heavy mortality.

Mr. W. Kearney: Can Mr. McCall tell us what those birds are fed on?

Mr. F. J. McCall: Grain, meat, etc.

Major Tissie: Outbreaks of fowl cholera are frequent in Madagascar. In January, 1922, we were sent to Antsirabe to investigate an outbreak of disease amongst poultry which had been reported by the manager of Saupiquet's preserves factory. For two years heavy losses had occurred amongst ducks and geese whilst under preparation prior to slaughter. The total mortality reached 9% in 1920, 8% in 1921, and in view of this it was proposed to close down the factory unless such losses could be checked.

History and symptoms. Birds purchased on open markets from one to a few days previously lose their vitality and they become dull, sleepy, the wings droop and the feathers are ruffled and from time to time the necks are extended. The comb takes a brownish hue, diarrhoea is present. This is at first greyish then it becomes blood-stained, dyspnœa is present and there is loss of co-ordination followed by convulsions and death.

Course. The disease runs a rapid course; death supervenes within 12 to 24 hours, sometimes less, as one goose died within three hours.

Lesions. On plucking the bird the skin presents a marbled appearance. On opening the carcase the crop is full of ingesta, the intestines contain a yellow viscid material, often blood-stained.The liver is congested and friable. The lungs are also congested and the pericardial sac always contains a pale yellow serous fluid.

Bacteriological diagnosis. The causal organism in the blood is an ovoid, bipolar, gram-negative bacillus, easily stained with Ziehl's dilute fuchsin. Cultures in alkaline chicken broth give a uniform opacity at first, but the medium gradually clears up through the organisms dropping down to the bottom and there form a thick deposit. On agar the organisms grow within 24 hours forming a thin greyish-white film over the surface. These cultures were obtained at room temperature.

Diagnosis. The post-mortem lesions, the rapid course of the disease and the presence of ovoid bipolar bacilli in the blood, allow a prompt diagnosis to be made. One experiment was carried out: two healthy hybrid ducks were placed in a pen which was believed to be infected. One of these birds died next morning showing all the lesions of fowl cholera, while the other died three days afterwards.

Treatment. The runs, with floors consisting of ordinary rammed down soil, are to be condemned. The poultry must be kept in cemented enclosures which must be cleaned daily. Iron cages used for the transport of birds from markets to the factory should be sterilized by flaming.

Vaccination. The vaccine consists of the following:—

A five-day old culture of the organism in chicken broth ...	100 c.c.
Ether	1 c.c.
Carbolic acid	.5 c.c.

The dose is 1 c.c. for chickens two to three months old, 2 c.c.'s for young ducks, geese, turkeys and adult fowls, 3 c.c.'s for adult ducks, geese and turkeys. A second inoculation is carried out eight days after the first and both are done subcutaneously, the first under the right wing and the second under the left.

Mr. H. E. Hornby. May I refer to parasites of the skin as being very common and harmful to poultry in Tanganyika Territory? Internal parasites are also frequently met with on post-mortem examination.

Dr. Viljoen refers to poultry diseases in South Africa and mentions that the industry is beginning to be looked upon as an important one. The same applies to these colonies and not only have the European settlers good fowls, but the natives themselves are gradually grading up their breed.

A. SPECIFIC ANIMAL DISEASES.

(11) Helminthiasis.

Mr. H. E. Hornby (Veterinary Pathologist, Tanganyika Territory): Whatever justification we may have for stating that other diseases are not receiving the adequate attention of investigators, we cannot complain of the quantity and quality of recent work on the diseases of domesticated animals due to worm infestation. Zoologists all over the world are working on classifications and life histories, pathologists are investigating the effects of the parasites on their hosts, pharmacologists are experimenting with drug treatment, while field veterinarians are applying and amplifying the results of laboratory work.

A list of the worms which have been found in or preying upon almost every tissue of every species of domesticated animal in Africa would be a most formidable one, but it is being increasingly recognised that no animal lives unto itself and that the mere presence of a few worms within the alimentary tract, or elsewhere of an animal does not necessarily constitute a condition of helminthiasis. These opening remarks will be confined to references to the most important of the worms with which we have to deal.

The strongylidæ of equines have occupied the attention of many systematists and some pharmacologists during recent years, yet their constant and harmful presence in the horses and mules of Africa show that veterinarians and stock owners are not adequately applying our existing knowledge.

Less reproach is attached to field veterinarians over the matter of haemonchosis of sheep. The work of, particularly, Ransom and of Curtice in America and of Veglia in South Africa, has furnished means for enormously reducing losses from this disease. It may not be sufficiently widely known that young cattle, as well as sheep, frequently die as the result of infection. I have found that the lines of treatment recommended for sheep are also suitable for bovines.

Oesophagostomum infection of cattle and sheep still requires much attention. Thanks, again, largely to Veglia, we know a good deal about the life history at any rate of *O. columbianum*, but we are still without an effective cure.

Since the last Pan-African Veterinary Conference there has been a revolution in our knowledge of the life history of ascaris, owing to the work of Stewart and of Ransom. I tried to bring the life history of *ascaris vitulorum* into line with that of the roundworm of the pig, but although I failed to find migrating larvæ in calves' lungs, a worker in the Philippine Islands has recently announced his success.

I should like to call attention to the interesting genus *Thelazia*, about which Mr. Griffiths, of Nyasaland, has recently contributed an informative article. A point which appears to have been overlooked is that injury to the eye is apparently due to a toxin against which a satisfactory anti-toxin can be turned out by the host. Consequently, in countries where such verminous ophthalmia is common one frequently encounters animals with clear eyes which yet harbour many worms in their conjunctival sacs.

Cysticercosis is common in cattle and pigs throughout the greater part of Africa and if ever this country is going to export carcases, its veterinarians must collaborate with their medical confreres in applying the knowledge which is already at their disposal to the extermination of the parasites.

Finally, I must emphasise the importance of one form of helminthiasis the ravages of which are insufficiently appreciated. That is, distomatosis of bovines due to *Fasciola gigantica*, the common intermediate host of which is *Limnæa natalensis*. Large areas of excellent grazing land are to-day spoilt for ranching purposes by the presence of infected snails. I know of no practicable measures for dealing with the disease on these ranches of which the best grazing lies alongside great, swampy rivers. The only drug we know of which seems to be useful in expelling flukes from the liver, namely, Male Fern extract, is too expensive for general use. Altogether, we have still in this disease a problem of great economic importance.

The Chairmain: There is one point which has been touched upon and that is the presence of *Cysticercus bovis* in cattle. We possess knowledge which will enable the condition to be controlled or eradicated, if made capable of application, but that day is not yet. Reasoning from the knowledge in our possession, are we justified in passing the carcase of an ox in which *Cysticercus bovis* occurs and if not, how many of the parasites are necessary to justify condemnation? It has often struck me what an excellent chance there is that the *Cysticercus bovis* be not even found and I sometimes think that very often more carcases are passed containing this parasite than are kept back. An indication from this Conference as to action would be of value.

Is there legislation on this matter in Madagascar?

Major P. Tissie. No.

The Chairman: Have you any legislation on the matter in South Africa?

Mr. W. M. Power: No. And the position is as you say, Mr. Chairman, at one time they used to condemn the whole carcase for a slight infestation.

The Chairman: It is a question that is very often raised by the Medical Department.

Mr. F. J. McCall: This is a question the elucidation of which might well be taken up by the medical and veterinary professions in collaboration

Infection from *Cysticercus bovis* is very common in Tanganyika and it is questionable if many cattle are absolutely free from the condition. In Dar-es-Salaam we condemn the carcases of animals which are heavily infested. Those which are lightly infested are boiled and sold in the native areas. If only one or two cysts are discovered and the condition is limited to one quarter that quarter is boiled and the remainder of the carcase is passed. The whole question is a difficult one and at present depends to a great extent on the opinion of the officer examining and I fail to see how a definite standard can be laid down.

Cattle from the grazing grounds of the nomadic peoples and from sparsely populated areas are relatively clean; cattle from the vicinity of townships are heavily infested. We strive to ameliorate the condition by discouraging the accumulation of large numbers of trade cattle in the township areas. I have been unable to obtain figures relating to incidence of *Taenia saginata* infection amongst European and natives.

There is, indeed, a vagueness about the whole question which urgently requires clearing up as I am not satisfied that our present policy is justified and is other than one of expediency.

Sanitary. Educational propaganda, similar to that which has produced such good results in connection with the hook worm problem, is strongly indicated, and as a start measures for the provision of adequate latrine accommodation in all townships and villages should be inaugurated.

It would certainly be most helpful if this Conference could make some recommendation and yet the more I think of the matter, the more it seems to me that you can do nothing.

The Chairman: Has Dr. Viljoen any later information as regards helminthiasis?

Dr. P. R. Viljoen: I do not think that I have any new information to bring to your notice except that I can confirm what Mr. Hornby has said with regard to the treatment of wireworm.

At the present time hæmonchus infection in sheep and cattle is not feared in any way because the treatment advocated by our division has been found to be so extremely successful that where formerly sheep farming could not be carried on, large flocks of sheep are running to-day. Moreover, the infection becomes less and less as time goes on.

Nodular worm disease in sheep, caused by *Oesophagostomum columbianum* is a very much more serious problem, and, as I mentioned earlier at this Conference, this disease has been masked for a long time by wireworm infection. Only when the latter was exterminated by the regular and extensive use of the Government wireworm remedy in the Union, have we been made to realise how serious the other parasite was. As Mr. Hornby stated the life history of this worm has been practically worked out. There are a few points which require elucidation, but on the whole, we have a clear conception of the various stages through which the parasite passes in its development. The most interesting point is that the larval worms do not remain for any length of time in the nodules as we at first supposed. They pierce the epithelial layers of the mucous membrane and enter the mucous membrane itself. An inflammatory action is set up around the parasite and gradually the visible nodule is formed. The larva, however, only remains in the mucous membrane for an average period of six or seven days and then goes out again into the lumen of the gut to feed again on the mucous lining. Our earlier idea was that the larva remained there for a very long time and in many cases it became calcified in the nodule.

In the course of these investigations it was found that the larvæ very often wandered through the wall of the intestine and so enter the peritoneal cavity. The result is, as you can imagine, that a serious peritonitis is set up and undoubtedly a good many sheep die from this cause.

I do not intend to deal with the treatment that may be adopted, for the simple reason that so far we have not found anything very satisfactory. The position taken up by the parasites in the large intestines makes it extremely difficult to find any drug that would act on them in that situation.

We have an idea and I may say we have reason for believing that this is so, that tobacco in leaf form is likely to be effective in expelling these worms. The theory one works on is simply this, that by giving material in solid form, like tobacco leaf, it has a very much better chance to pass through the stomach and the small intestines and so reach the large intestines in still fairly strong form. The nicotine should still be present in the solid tobacco and assert its effect on the worms. This appears to be the most hopeful treatment that we can foresee at present. The tobacco can be used also as a preventive measure in the sense that it may kill off the worms before they reach their final destination; it is thought that it might be of some use if tobacco in leaf form or cut tobacco were given to sheep in a salt lick. We have had no actual experience with this yet, but no doubt very shortly we shall have more information on this point.

With regard to the other parasitic diseases mentioned, I do not feel justified to add anything to what has been said. I may mention, however, that we recommend plenty of salt to be given to sheep and other animals in infected liver-fluke areas and that as far as one can gather this preventive method has had fairly good results. The salt, in fairly strong concentration, has I believe, a toxic effect on the young parasites before they reach the liver.

With reference to the *Cysticercus bovis*, it seems to me that this matter requires further investigation. Only recently we had some interesting questions put to us. It was contended by some farmers that visible measles were actually seen in calves only about a fortnight old. Now, from the literature that is available on these parasites it would appear that this is quite out of the question; it is quite impossible for the parasite or cyst to develop so rapidly as to become visible in that short period.

It was suggested that the infection may have been contracted before birth, but this is extremely unlikely or almost impossible. There is no case on record and I do not think for a minute that the idea should be entertained. As I said before, we shall have to go into this question very shortly, perhaps for the very good reason that the life histories of these different parasites have been worked out a very long time ago and usually the work has been done in European countries.

You will remember a remarkable discovery that was made in South Africa regarding the life history of the sheep-scab parasite. I simply mention this as an analogy and to show that one should be careful in accepting statements made in very old text books.

Mr. J. A. Griffiths: I would like to draw Dr. Viljoen's attention to the possibility of pre-natal infection. Is this not known and possible? I think that you can get it in the case of ascaris. I do not think that anyone has tried by feeding experiments to transmit cysticercus infection to the fœtus.

Dr. P. R. Viljoen: I was referring to cysticercus, not to ascaris.

Mr. J. A. Griffiths: If you get these parasites circulating in the blood in the case of a pregnant animal then it is possible they may pass on to the fœtus.

Major Paul Tissie: Parasites found in Madagascar are the following:—

1. *Skin parasites.* Fleas and jiggers affecting dogs and pigs. Jiggers belong to the genus *sarcopsylla* and are found in the pig on the lower extremities of the limbs, about the mammary gland in females and around the scrotum in males. Insects of the sub-order *nematocera* as simulium and mosquitoes, those of the sub-order *brachycera* as stomoxys and hippobosca, but no tsetse. Amongst the arachnoids we find parasites belonging to the *ixodidæ*, *sarcoptidæ and demodicidæ*. *Ixodidæ* or ticks are very common in Madagascar. Amongst them we have found: *amblyomma hebræum*, *amblyomma pomposum*, *boophilus annulatus*, *ixodes hexagonus*, *margaropus annulatus*, *ornithodorus moubata*, *ixodes ricinus*.

2. *Intestinal parasites.* Trematodes: Amongst those we find in the order Distomeæ: Amphistoma which are found in large numbers in the rumen causing no inconvenience and Gastrodiscus which had previously only been reported from Egypt, Senegal and Guadeloupe. These were found on three different occasions on post-mortem, *i.e.*, once in a mule and twice in horses. They were all found in the large intestine. In the last case over a thousand of these parasites were found in the large intestine without causing any apparent inconvenience to the animal, which was slaughtered for advanced lymphangitis. The mucous membrane of the intestine was quite sound, we were surprised at this, as Veterinary Officer Nainsouta of Senegal had reported two cases of peritonitis with perforation of the bowel caused by those parasites.

Nematodes: These are very numerous: all affect the alimentary tract except Stephanurus, which are found in the urinary organs of pigs.

(*a*) Oesophagus and stomach. In two horses we have found tumours containing *Spiroptera megastoma* between the mucous and muscular layers of the stomach.

Spiroptera are also very common in dogs, they cause tumours in the œsophagus, stomach and aorta. We have also found many cases of *spiroptera strongylina* affecting the stomach of pigs slaughtered for consumption.

(*b*) Intestines. Intestinal nematodes are very frequent, in 47 post-mortems carried out on horses we found: 41 subjects affected with sclerostoma, 4 with oxyures and 2 with ascarides. *Ascaris megalocephala, sclerostomum armatum* and *tetracanthum, oxyures curvula* and *mastigodes* have been noted in the horse. In bovines one finds *ascaris vitulorum* which is very common in calves, and œsophagastoma. Mortality amongst calves due to ascarides may be very high, sometimes as many as 50% of calves dying in certain districts. Sheep are affected with *œsophagostomum columbianum*. In pigs *echinorhynchus gigas* is frequent; this parasite possesses very powerful mouth parts and sometimes succeeds in causing perforation of the intestine. Less frequently pigs are found affected with œsophagostomes and ascarides. In dogs oxyures and uncinaria are fairly common, but do not cause any symptoms.

Cestodes are seldom found, except in the dog, *dipylidium caninum, tænia serrata* and *marginata* and *bothriocephalus latus*.

Echinococcosis of the liver is common in pigs, less so in the ox.

Cysticercus tenuicollis is frequently found affecting sheep's livers.

(*c*) Serous cavities. *Cysticercus tenuicollis* is found in the peritoneal cavity of sheep and oxen.

(*d*) Connective tissues. Chretien was the first veterinarian to note the presence of onchocerca in the connective tissues around the lymphatics and tendons of almost all oxen slaughtered in the northern part of Madagascar.

(*e*) Respiratory organs. *Strongylus pulmonaris* is very common in calves and *strongylus paradoxus* in pigs. Infection with these takes place on damp pastures and bomas.

(*f*) Circulatory system. We have found on post-mortem one stallion affected with aneurism of the posterior aorta due to *sclerostomum armatum*. Aortic aneurisms in dogs due to spiroptera are not rare.

(*g*) Muscles. In Madagascar about 10% of pigs are infected with *cysticercus cellulosæ* (tænia solium of man). This is natural, for frequently pigs share the abode of natives and act as scavengers.

Cysticercosis of oxen is very rare, three cases were met with in 1914-1915 out of 115,000 oxen slaughtered at Boanamary.

(*h*) Urinary apparatus. *Stephanurus dentatus* is found in the urethra and kidneys of pigs. This parasite is very rare in most parts of Madagascar, but it is frequently found in pigs reared near the Lakes Alaotra and Itocy. At the slaughter-house in Tamatave 100% of pigs derived from Ambatondrajaka are found infected with stephanurus. There is often only one kidney affected and in that case it is invariably the left one. It is possible that pigs reared in those marshy districts get infected through eating snails which are found under the leaves of aquatic plants.

Pigs do not die from this infection: in one case we found an infected pig with kidneys weighing four kilos, although the condition of the animal was quite good. The flesh of affected pigs is fit for consumption although sometimes we notice it tainted with a slight smell of urine.

The Chairman: Have hæmonchi been found in Madagascar?

Major Tissie: No cases have as yet been observed.

Mr. J. A. Griffiths: It has been proved that with the ascaris parasite prenatal infection may take place. Several workers, Japanese and American, have proved this experimentally. I do not think there is so much difference between the method of infection in this parasite and *systicercus*.

Dr. P. R. Viljoen: I was referring to cysticercus.

Mr. W. M. Power: I will explain as regards some young calves that were sent from Maritzburg to the Abattoir at Durban.

Four animals, calves, were sent, one of which was condemned by the veterinary officer. The calf was only 15 days old and it was wondered how could this be measles. No definite information was obtained as to how they got measles.

Mr. J. A. Griffiths: Another parasite Major Tissié mentioned was onchocerca which has caused large financial losses in Australia, as they were unable to send a considerable portion of each carcase to their market in London.

Major P. Tissie: We found quite a number of cases in Madagascar.

Mr. J. A. Griffiths: Have they been seen in the brisket?

Major P. Tissie: Yes.

Mr. J. T. C. BRADSHAW: A large number of animals died on a farm in the Nakuru area and when I arrived at the place the losses had been very heavy, carcases being scattered all over the place: no less than seventy beasts having died within the 36 hours immediately preceding my visit. On inspection of the animals they were found to be infected with numerous leeches in the mouth, pharynx, œsophagus, etc.

Post-mortem examination shewed that the animals had been practically bled to death. The amount of blood in the carcase being very scanty and watery. The only cause for this heavy mortality that could be discovered was the high infestation of leeches.

On another estate this year similar losses occurred, apparently due to that same cause, but the number of deaths was much smaller than in the previous case.

The diagnosis arrived at was, that when numerous leeches infect an animal they are capable of bleeding the animal to death.

Mr. H. H. BRASSEY-EDWARDS explained the sanitary procedure in connection with measly cattle and calves adopted by the Nairobi Municipal Council.

Dr. P. R. VILJOEN: There is one other point which may be overlooked. These cysts are not dangerous for human consumption until the parasite has reached maturity.

THE CHAIRMAN: A large number of cysts are a danger if eaten. Natives, I understand, however, like to cook their meat well in some countries.

Mr. J. A. GRIFFITHS: I suppose it would depend on what natives you refer to when you say that they always cook their food well?

Mr. H. H. BRASSEY-EDWARDS: In the Annual Reports of the Medical Department of this country it is reported that a large number of natives are affected with tapeworm.

I am of opinion that certain natives in this country prefer only half-cooked meat.

Mr. F. J. MCCALL: I consider that the matter should be enquired into further by various laboratories in order to throw some further light upon the subject.

Mr. J. A. GRIFFITHS: Would Mr. Brassey Edwards state his experience of the numbers of sheep's liver infected with *stilesia hepatica* and how he deals with them.

Mr. H. H. BRASSEY EDWARDS: There is a very high infection in this Colony and the liver is usually condemned and destroyed.

Mr. J. A. GRIFFITHS: I always condemn the whole liver, but I know natives who have eaten them, after cooking, for the past two years without any apparent harm.

Mr. H. E. HORNBY: So much satisfactory work has been done in recent years and the knowledge is so readily available that grave losses from most helminthiasis need not be feared.

I may mention two points in connection with hæmonchosis. The first is that while ground which is grazed almost exclusively by sheep can be made clean by regular dosing, this is not the case when cattle, game or other ruminants graze over the same ground as sheep and only the last named are dosed. The second is that the relatively less susceptibility of goats, as compared with sheep, has not been explained.

Oesophagostomatosis and distomatosis still remain problems which require much further work. At the present time in East Africa meat inspection certainly helps to protect the European population from tapeworm infection, not only by preventing grossly infected material being delivered to Europeans, but also by the fact that the frequent condemnations of carcases keep the subject to the fore, and Europeans are reminded of the necessity of always well-cooking their meat. Any campaign for the eradication of human tapeworms and animal cysticercosis will need the united efforts of the medical and veterinary professions working in collaboration.

A. SPECIFIC ANIMAL DISEASES.

(12) Skin Diseases.

Mr. F. J. MCCALL (Chief Veterinary Officer, Tanganyika Territory): As doubtless you will remember, at the preliminary meetings of this Conference when the Agenda was under discussion, I asked that the subject of skin diseases should be introduced: the suggestion was rather thoughtless and yet while regretting the fate which has fastened upon me the responsibility of acting as reporter, I do not regret its introduction, as in it are included several diseases of paramount and peculiar importance to the East African territories.

I do not propose to more than refer to such well known maladies as ringworm, ovine and equine mange, sheep pox, chicken pox, etc., as such fall into the category of diseases, the etiology and treatment of which have been worked out to such a fine point that the application of well known remedies is usually attended with success. I feel sure, however, that Delegates present will welcome the further views which any member may care to advance on these important and better known conditions, because debatable points still exist with regard to even the best thrashed out subjects.

Demodectic Mange. One of the diseases which I had in mind was demodectic, or follicular mange of cattle. This malady is common in many parts of Tanganyika and has been reported from Nyasaland and from Rhodesia. Its development is slow and many cases appear to be chronic: the first symptoms observed are the appearance of several small thickenings of the skin, the hairs on the top of which are raised and glued together: pressure of such little nodules causes the expulsion of a white thread of inspissated pus and sebaceous material, which on microscopical examination is seen to contain great numbers of the parasitic acari. The nodule in short, is simply a sebaceous gland similar to a stopped pore on a man's nose, the thickening due to irritation caused by parasites breeding and living in the lumen of the gland.

The condition is most intractable and does not yield to dipping or antiseptic treatment. It is estimated that in certain districts in Tanganyika possibly 2% of the cattle are infected. Slaughter of infected animals and burning of the hides is indicated.

The other disease calling for special attention is, I think, streptothricosis of cattle. This condition, known to the Mwanumwezi and Wasukuma as "*Madiniri*," is characterised by the appearance of a horny thickening of the skin especially along the back. It is most frequently seen amongst old cattle: is very chronic and seems to become aggravated during the wet season. It does not yield readily to ordinary arsenical dipping: when it occurs amongst grade or pure-bred stock the manifestations are much more acute and death frequently supervenes.

The causal organism is a Streptothrix and I think our Chairman can tell us something about its nature.

The disease is reported in the Congo and is prevalent in Kenya. I have seen an analogous condition affecting the mouth and legs of imported Merino sheep. It would seem to be associated with tick incidence.

I have only given a rough sketch of this condition, but trust the matter may be of sufficient interest to raise discussion and bring to light the views of other Delegates who may be interested in skin diseases.

Sheep Scab. In the native flocks to-day, we know that sheep scab is present, but that when the condition is encountered in purely native sheep the disease is not so serious as when met with in the grade varieties. For this reason, amongst the native tribes the disease has not received the attention to which it is possibly entitled. We recognise the impossibility of instituting an efficient system of dipping for native sheep. In Kenya, our confreres, however, must consider, and are considering, measures for the control and eradication of sheep scab.

Mr. W. Kennedy. Mr. McCall said we are considering measures for the control and eradication of sheep scab in this Colony. This is not quite correct. Few of our European-owned flocks are free from this disease, but the control and eradication of it is a matter which has been left largely in the hands of the farmers themselves. Most of them have been advised as to the means by which they can eradicate the disease from their flocks, but I understand that few have made a serious attempt to do so. There is a large traffic of native-owned sheep through our settled areas and although, as Mr. McCall remarked, the disease does not give rise to a serious condition in these haired sheep, nevertheless, they are carriers of the disease. The question does not only involve the eradication of the disease in European-owned flocks, therefore, but also the prevention of infection, by controlling the movement of sheep between the native reserves. This movement cannot be effectively controlled at present.

With regard to skin diseases in cattle, no cases of demodectic mange have been reported in this country and if it does exist, it cannot be the cause of serious losses.

Streptothricosis is common in cattle, particularly in some of the native reserves. A veterinary survey recently carried out in the Lumbwa Reserve revealed the prevalence of this disease in that area. Dipping has been tried on European farms without producing any marked effect on the condition, but it would appear that it has a slight effect in controlling its spread.

Ringworm is common in calves on practically every farm in this Colony. This condition, sometimes associated with the presence of lice, is a common cause of hair balls in calves.

Mr. J. A. Griffiths: About ten years ago we had the disease demodectic mange in an epizootic form amongst European-owned cattle. In some cases as many as 100% of infected herds were found to be diseased and quite a number of deaths took place, chiefly from septicæmia. In the fatal cases the disease was complicated with streptothricosis. We dealt with the disease by slaughter of all infected animals and that is what we do now. With regard to native cattle I do not think we have more than about 1% infected. Regular dipping has had the effect of practically eradicating demodectic mange and streptothricosis of cattle in the areas of European settlements.

Mr. H. E. Hornby: At one time, next to trypanosomiasis, the chief causes of mortality amongst European-owned cattle at Fort Jameson in North Rhodesia were skin diseases; hundreds of bovines either dying or being destroyed annually owing to their being infected by follicular mange or "Streptothricosis." There is no doubt that the two conditions are separate, although frequently they are met with on the same animal. The susceptibility of grade and pure-bred stock to these diseases is much greater than that of native stock and both these conditions are indigenous to Central Africa and rarely cause heavy mortality among pure-bred native cattle, these latter generally escape severe infection. That the diseases do exist in every part of Central Africa would be shewn if one made a careful examination of even apparently clean herds.

When European cattle are infected the diseases become very serious and heavy losses occur. Concerning treatment, I have recently tried subcutaneous injections of 2½% carbolic acid for follicular mange and the results are sufficiently good to justify giving the method further trial. "Streptothricosis" is easier to treat because the lesions are not so deep seated. An important point in connection with "Streptothricosis" is its seasonal exacerbations. The development of the parasite on the animal's body needs warmth and moisture and so is most rapid when the rains are on. In the dry season the lesions are of a chronic nature, scabs are formed and not much progress of the disease is made until the next rainy season. For this reason weak arsenical preparations should be avoided as they tend to carry the parasites to yet unaffected parts of the body, while a very strong disinfectant of almost any kind will kill the "fungus." All but the worst cases of "Streptothricosis" can undoubtedly be cured. The treatment of follicular mange is more difficult, but the fact that native cattle are highly immune to the disease and that spontaneous cures among such do occasionally occur, justifies curative measures being given a trial.

Mr. E. Hutchins: So far as I know only one case of streptothricosis has been diagnosed and I do not think the condition is common in Uganda.

Dr. P. R. Viljoen: I have listened with a great deal of interest to the discussion which has taken place in connection with the skin diseases of animals. In South Africa, none of the diseases, excepting scab in sheep, is of serious economical importance, scab in sheep, as you are aware, in the Union does not fall under veterinary administration, but is dealt with by a special division, namely, the Sheep Division in the Department of Agriculture. I do not wish to add anything further to what has been said on these subjects, but I should like to bring to your notice a comparatively new disease that has made its appearance in parts of the Union, the so-called "Sweating Sickness." I bring this to your notice under the discussion on skin diseases, not because it really is a skin disease, but simply because it results in rather a remarkable alteration in the skin. Sweating sickness attacks only calves as far as I know and makes its appearance during the summer months and in some cases assumes quite an epizootic form. The disease commences with an extraordinary high fever, so much so that the whole skin feels extremely hot to the touch. Very soon profuse sweating takes place all over the body, particulary in the regions behind the ears, behind the elbows and in the flanks. Usually it runs a very acute course, but where cases are rather protracted changes occur in the skin itself. These consist of exfoliation of the epidermis, thickening of the dermis itself and falling out of the hair. An animal that recovers from the disease, therefore, appears quite hairless. Nothing is known regarding the causation of this disease. The transmission experiments have so far failed completely. I may say that investigations are still proceeding in connection with this disease, but that owing to its localised occurrence in certain areas, material is not always available and for this reason research work is hampered to a considerable extent. I should like to know whether similar diseases have been observed in this part of Africa.

Major P. Tissie: In Madagascar mange caused by sarcoptes affects the horse, sheep, dog and cat.

Demodecidæ are the cause of mange which is much more refractory to treatment than the above, and, unfortunately, in Madagascar this type of mange is much the commoner. Veterinary Officer Geoffrey estimated that in 1912 in the Sihanaka province alone there was no less than 12,000 to 15,000 bovines affected with demodectic mange, in certain herds 25% to 30% of the total were implicated with an annual mortality of 6% to 10%.

Symptoms. This type of mange due to *Demodex folliculorum var. bovis*, developes slowly; at first one notices small nodules the size of small shot, those nodules, which are in the thickness of the dermis, consist of sebaceous glands crammed with demodex. They are grouped over areas the size of a one franc piece which later on tend to become merged together. The nodules then become transformed into abcesses which exude yellowish pus, mixed with serum and parasites. Ulcers covered with a scab are formed through rubbing, the skin becomes hard and thick and cracks in places. Affected animals cannot rest, appetite is, therefore, lost and rumination ceases until death supervenes, the beasts being in a complete state of marasmus.

Lesions usually first appear on the dewlap, which is well developed in Zebus, they then extend to the belly and dependent parts and finally invade the whole body. Pruritis is very marked especially during the heat of the day.

Diagnosis. The diagnosis presents no difficulty. One simply slices a piece of affected skin and finds the white dermis in which small yellow points are scattered, these are hypertrophied sebaceous follicles crammed with parasites.

Prognosis. The prognosis is unfavourable; when the lesions are generalised treatment is of no avail.

Course. Demodectic mange develops slowly, five to six months or more sometimes elapse prior to the disease involving the whole skin. Affected animals usually die.

Treatment. Slaughter of extensive cases; Cooper's dip and applications of diluted paraffin seem to have been effective in some cases.

Demodectic mange in pigs: This is due to *demodex folliculorum var. suis*. Cases are not so frequent in pigs as in bovines. The disease does not interfere with the process of fattening. In 1922 we found lesions caused by demodex which had perforated through the skin and involved the superficial layers of the fat.

Amongst worms affecting the skin there is only one found in Madagascar: this is a filaria which causes "Summer ulcers," composed of yellow calcareous granular tissue. These ulcers disappear during the cool season and re-appear during summer.

Treatment. Copper sulphate in 30% solution.

Diseases due to fungi of the trichophyton group are rare in horses, but more frequent in bovines.

Mr. F. J. McCall: It would seem from the view of the various Delegates that of skin diseases occurring in Eastern Africa, apparently demodectic mange is the most serious and it appears to be confined to Nyasaland, Tanganyika, Northern Rhodesia and Madagascar.

Mr. Hornby expresses the view, that the two conditions, Demodectic mange and streptothricosis are very often found concurrently in Rhodesia. In Tanganyika I have not observed this as a striking feature, but possibly the reason may be that in Northern Rhodesia almost all the cattle are kept in bush country and it is in bush country that ticks are most numerous and where ticks are most plentiful streptothricosis is most prevalent. In many of our open areas, where no streptothricosis exists, we find that demodectic mange is common.

With regard to spontaneous recovery, Mr. Hornby observes what has happened in a few cases. I do not think he wishes to convey the impression that such recoveries are common.

I think in view of the seriousness of the condition, a resolution might be put forward by this Conference with regard to the matter. More particularly do I say this in view of Mr. Griffith's remarks on the epizootic character which the disease assumed in Nyasaland. Provided it is not already existent in Kenya, we know that on the Kenya border it is to be found.

Sheep Scab. I think there remains nothing much to be said on this subject. The Union authorities in South Africa and Governments in all civilised or semi-civilised countries effectively deal with the disease, but it would appear that in the practically uncivilised native areas of Eastern Africa it is not one that would justify the erection of dips and that to attempt any other methods of control or eradication is not advisable.

Mr. Kennedy's remarks on the attitude of sheep farmers are illuminating, but in that the woolled sheep is not present to any extent in the other East African territories, that aspect of the case I do not think calls for further comments. We all agree that the efficient application of known remedies is effective in eradicating any outbreak.

With regard to "Sweating sickness," I am afraid this is the first I have heard of it. We do not recognise the condition in Tanganyika.

THE CHAIRMAN: It is scheduled in Southern Rhodesia.

Mr. F. J. McCALL: Coming to streptothricosis in cattle, I think that the general expression of opinion is that amongst grade or imported stock the condition is most serious and it would seem that early detection and intensive local treatment with strong antiseptics, when the disease is still confined to small patches on the animal's body, are indicated.

My experience concurs with that of Mr. Hornby that dipping does not seem to have the beneficial effects one would wish. Undoubtedly, I think the dryness of the climate has an influence on the incidence of the disease, its absence from the Sudan and its comparative scarcity in dry areas supports this contention.

A. SPECIFIC ANIMAL DISEASES.

(13) Plant Poisoning.

Dr. P. R. VILJOEN (Sub-Director of Veterinary Education and Research, Pretoria): I certainly hesitated a great deal before agreeing to undertake the task of introducing the subject of Plant Poisons to this Conference. The reason for this is that the subject is such a big and important one and that in order to do justice to it a great deal of preparation would be necessary. In my case, unfortunately, I have not had any time nor any literature to refer to on this matter. It is certainly one of the most important and fascinating studies in the whole sphere of veterinary science. A great deal of work on poisonous plants, or suspected poisonous plants, has been done in the Union in recent years. There are many diseases which have been connected in some way or other with the veld: I need only mention Lamsiekte. While I was engaged on research work into the origin and causation of this disease, I can safely say that well over 100 different species of plants were fed experimentally.

The most interesting and important features in connection with the discoveries that have been made in diseases set up by plant poisons, are the following:—

(1) That in some cases the animals shew definite fever which, as you are aware, had not been previously associated with plant poisoning.

(2) The remarkable discovery was made that something similar to an incubation period, known in bacterial diseases, can also be present in some cases of plant poisoning. We have had to deal with diseases in animals, which so closely resemble infectious diseases, that it was extremely difficult to associate plants with their causation.

The main difficulties encountered in the study of diseases caused by plants are the following: (1) some plants are only poisonous at certain stages of their growth; (2) some plants only possess toxic properties under certain climatic conditions; (3) many of these plants are only eaten by stock at certain times of the year; (4) some plants are only eaten by certain stock.

From what I have told you, you will realise the necessity for working on the spot, as at any rate in the commencement of feeding experiments, perfectly fresh plants should be used. It has also been definitely shewn that it is not possible to forward certain plants from the farm for feeding elsewhere, because local factors enter into the causation of the disease set up by them. I may mention, and I think it is only right I should do so, that most of the important discoveries that have been made by our Division in the matter of plant poisons, have been due mainly to the assistance of our farmers. I was very pleased to hear Mr. F. J. McCall this morning remark that he has also found the Dutch farmers to be very observant people, and it is mainly due to this characteristic in the farmer, that we have been put on the track of certain poisonous plants. The subject is brimful of difficulties, and it would take a very long time to go into details of all the known poisonous plants. I propose, therefore, to select only some of them, and to mention very briefly the diseases set up by these plants.

The first one I may refer to is that set up by *Senecio*, known as *Ragwort* in England. This plant occurs in various parts of the Cape Province, in particular; poisoning can be set up by it in both cattle and horses. In cattle the disease alleged to be caused by the plant is known as *Molteno* cattle disease, or also as "Straining disease," the former name being applied because the disease was particularly prevalent in the *Molteno* district.

I do not intend dealing in detail with the symptomatology or post-mortem findings, in these poisonings, but the main features may be mentioned under the heading of the different plants.

In a case of *Senecio* poisoning in cattle, the most characteristic symptoms are, severe straining followed by purging and signs of abdominal pain; brain disturbances sometimes may also develop, and death usually ensues after about three days. From the symptoms mentioned by me, you will at once conclude that the post-mortem lesions would be in the form of gastro-enteritis. In addition there is parenchymatous hepatitis in horses, and in these animals the poisoning appears

to be cumulative in its action. The chief symptoms are jaundice, loss in condition, colic, uncertain gait: later semi-consciousness, great increase in the heart beats, which later on become practically imperceptible. The post-mortem findings are mainly degeneration and inflammation of the heart and liver.

I will next deal with the so-called *Slangkop* poisonings. *Slangkop* poisoning is produced in the different provinces of the Union, by different species of plants; in the Transvaal it is set up by *Urginea Burkei*, in Natal by *Urginea Nacrocenta*, and in the Cape Province by the *Ornithoglossum Glaucum*. The last mentioned plant, as far as I am aware, has not definitely been proved to be poisonous to stock; I shall therefore only refer to the *Slangkop* poisons of the Transvaal and Natal. I may mention that the whole plant has been found to be toxic, and also that both fresh and dried specimens contain the poison. Some samples are extremely poisonous, 2 or 3 ounces being sufficient to produce symptoms. The danger of this plant is that it appears very early in spring, before any other new growth in the pasture makes its appearance, the result being that animals on dry pasture, are inclined to ingest this plant.

The symptoms can be referred mainly to gastro-enteritis, and inflammation of the kidneys. I may mention that *Slangkop* poisoning occurs chiefly in cattle and sheep.

I will next refer very briefly to the so-called *Tulp* poisons. There are two separate genera of *Tulps*. Which have been accused of producing poisoning in stock. The one is known as *Yellow Tulp* or *Homeria*, which occurs chiefly in moist places, vleis, on river banks, along water furrows, etc., and also makes its appearance early in spring.

The other *Tulp is* known as *Blue Tulp* or *Morœa*. The whole plant is poisonous, and in this case, also, both the green and the dry specimens have been found to be toxic. Poisoning occurs chiefly in cattle and sheep, and is particularly noticeable when these animals are brought on to a new farm where this plant grows. It also occurs very frequently in animals which are in a hungry condition, particularly after a railway journey.

The symptoms briefly, are acute gastro-enteritis and tympanites followed by increasing weakness, and finally stupor. Deaths are sometimes very sudden, within 12 hours, but the disease may last for as long as 4 or 5 days.

The next plant for consideration is the so-called *Giftblaar*, or poison leaves, called scientifically *Dichapetulum Cymosum*. This plant is found in certain parts of the Transvaal, but I am not aware of its occurrence in any other Province. It occurs specially at the foot of certain mountains, particularly along the Magaliesburg Range. Recent experiments have shewn that only the young leaves of this plant are toxic; poisoning of stock therefore occurs mostly in the Spring, but cases had also been observed in other seasons of the year, and it was difficult to account for these. Recently, however, it has been shewn that a new batch of young leaves may come out at another time of the year, and this accounts for the poisoning set up during different seasons. In this condition cattle are mostly affected, and deaths usually occur very suddenly in the veld; hence cases of poisoning showing clinical symptoms do not often come under observation.

Now I might refer to another condition, *Gouwziekte* in sheep. It occurs only in certain parts of the Transvaal, so far as I am aware, and it has been proved after most extensive experimental work to be caused by a poisonous plant, namely, *Vanguerla*. The peculiar thing about the disease is, that symptoms may only develop several weeks after the plant has been ingested by the animals. Apparently the plant has a toxic action on the heart, which undergoes degeneration, and in the end becomes extremely dilated. On driving a flock of sheep on a *Gouwziekte* farm, it happens that during this exercise, sheep drop dead suddenly, the cause of death being heart failure. The post-mortem findings shew dilatation of the heart.

Another interesting condition that one might refer to is the so-called *Geeldikkop* in sheep, which literally means "*Yellow Thick Head.*" This disease has existed in some parts of South Africa for many years, and the plant which has recently been proved to be the cause of it was for a long time suspected. The etiology of the disease could only be cleared up by most extensive and careful feeding experiments. The reason for this is, that the plant causing it, viz: *Tribulus Terrestris*, is only toxic under certain very definite climatic conditions. It has been found that only the green succulent plant, when in the flowering stage, and when fed during very hot days, would set up symptoms of the disease. It has not been possible to shew what the nature of the influence was, that the sun had on either the animal, or on the plant: but the fact remains that unless feeding experiments are carried out in the hot sun, no positive results can be obtained. The disease makes its appearance on a farm, usually when wilting of the plant takes place, as after recent rains. In connection with the symptoms and post-mortem appearances seen in this disease, the most important points are the following:—

(1) The sick animal shews a very definite fever; (2) there is an exudation into the cutis and sub-cutis; (3) this exudation in the skin is followed by necrosis of the epidermis.

In this connection I might mention that in an animal suffering from the disease, the ears, particularly, become hard and dry, and in the end, bits of the necrosed tissue may be broken off like tissue paper. The fourth important symptom is a general icterus, the yellow colour being seen throughout all mucous membranes of the body, as well as in the muscles.

Another genus of plants, *Crotalaria*, has been proved to be toxic in cattle and horses. In the horse, poisoning is produced by *Crotalaria Dura*, and the disease set up is characterized by destruction of the respiratory epithelium, and by the consequent very marked emphysema of the lungs. On account of the hurried breathing which follows, the disease has been named by the farmer *Jagziekte*, meaning really—Rapid breathing. The peculiarity about this condition is, that here also a definite fever is present in the sick animal, and, secondly, that an incubation period averaging about 50 days has been observed. You realise naturally that it may not be correct to use the term incubation period, but we have no other equivalent. The plant does not appear so highly toxic as some others, very large amounts being required to set up the disease, experimentally. So far as I remember now, it required about 40 to 50 lbs of the plant before symptoms of the disease made their appearance later.

The condition set up by *Crotalaria burkeana* in cattle, is called "Stiff-sickness," by the farmer. I should mention here, that in South Africa, we have several forms of stiff-sickness and that the cause of some of these forms is certainly not *Crotalaria*. The disease set up by *Crotalaria* is in the form of an acute laminitis, followed by marked proliferation of the horny hoofs of affected cattle.

Another interesting disease in South Africa, is the so-called "pushing disease." It occurs in certain parts of Natal, and about two years ago, was shewn definitely to be caused by cattle eating the plant called *Metricaria Nigellasfolia*. The name indicates the symptoms, which are mainly connected with the central nervous system, and as a result of the poison acting on this system, the animal shews brain disturbance, manifested by the peculiar habit of almost continually pushing its head against fences, and posts, etc.

The last condition I wish to refer to is the so-called *Krimpziekte* in goats: this disease has been shown to be caused by a plant called *Cotyledon Wallichii*. Symptoms of the disease are especially noticeable when the flock of goats is driven or disturbed in any way. The sick animals then begin to shew nervous symptoms, staggering gait, etc., and later on, convulsions: it is owing to these convulsions, that the name *Krimpziekte* has been given to the disease. These spasms occur at fairly regular intervals, and are very similar to those seen in strychnine poisoning. In the later stages, paralysis develops. Other species of plants have also been accused of setting up a similar condition in stock, and at the present time further investigations into the causation of the so-called *Krimpziekte*, are proceeding at Onderstepoort, and in other parts of the country.

I realise, Mr. Chairman, and gentlemen, that a good many of the Delegates have not met with any of these conditions in stock, and consequently my remarks give insufficient detail to form a real conception of the diseases, but I trust they have been of some interest to the Delegates present.

The Chairman: I am sure we are all extremely grateful to Dr. Viljoen for introducing this subject: from what he has said, and he has kept back a vast amount, he has indicated sufficiently broadly, the possibilities of plants in connection with the diseases of stock, and if we are not familiar with these diseases in this country, it is largely because our attention has not been brought to them by the owners. Secondly, our opportunities have been practically nil for field investigations. Many of the plants which Dr. Viljoen has referred to, today, as occuring in South Africa and being responsible for disease there, occur also in these territories: if not actually the same species, they are of the same genus.

Whether the respective Governments will consider the time opportune to carry out the investigations of what may be regarded as minor infections, will remain a point for their decision: but I do feel that we might co-operate in this respect, as mentioned already, with Onderstepoort, which is the pioneer in this line, and collaborate with them in the furnishing of material and collecting data, so that when the time is more opportune, we may be able to jump instead of crawl, with the knowledge so acquired.

One point I wish to mention, which Dr. Viljoen omitted, and that is the incubative period of *Metricaria*, which is about a month.

It is another of the conditions where there is a delay between ingestion and the development of symptoms. This form of poisoning takes us back to the middle ages, and, do we know where we are with regard to plant poisons? It seems to me the opening of a new science.

Mr. H. E. Hornby.—Plant poisonings may be of minor importance to us in Central and East Africa, compared with very severe diseases, but they are undoubtedly of great interest. Our trouble lies in the ignorance concerning both the plants and the symptoms and lesions they produce, which exists in so many parts of Africa outside the Union. So far as I am concerned, for years I have had

to diagnose as probable plant poisoning obscure cases of gastro-enteritis, cerebral disturbance etc., but what plants were incriminated in these cases, I do not know. These occurrences sometimes assume serious proportions. I remember when some 200 oxen were brought to a place in Northern Rhodesia, from Portuguese East Africa, and were put on a farm where were already running a thousand head of locally reared cattle. It was the commencement of the rains, and among the 1,000 head odd cases were occurring of what was called plant poisoning, but of the 200 no less than 100 became sick, and 30 or 40 died: I feel sure we were dealing with plant poisoning, but due to what plant I do not know.

Captain B. A. Jarvis, R. A V. C.—The principal article used as forage in the Sudan is a millet called *Dhoura*—one of the sorghums. Poisoning sometimes occurs in animals, which have been fed on the dry stalk of this cereal. It has been observed that poisoning has only occurred when animals have eaten the *Dhoura* stalk of a ripe crop, that has in some way been stunted in growth.

Samples of this stunted *Dhoura* stalk were forwarded to the Chemical Laboratories of the Wellcome Research Institute, the report being that a substance giving rise to prussic acid had been isolated.

I should like to ask whether any other Delegate present has encountered such a similar experience.

Mr. W. Kennedy.—We know very little of the poisonous plants of Eastern Africa. Very little work in this connection has been carried out in this Colony, but we are aware of the existence of plants which are reported to be poisonous in other countries. There is one condition in this country which attracted a considerable amount of attention in cattle a year or two ago. This condition is known as "turning sickness," and the prominent symptoms are a marked inclination to walk in a circle, coupled with amaurosis. Post-mortem examinations failed to reveal any lesions in the intestinal tract, and the only constant lesion present was hyperaemia of the meninges of the brain. Endeavours were made to transmit the disease by inoculation of blood without success. The mortality was about 90% and empirical treatment with various drugs was tried without any marked success. The natives attribute the disease to a poisonous plant, but we have so far failed to get any definite evidence on that point. I may say that this condition has been noted in various parts of the Colony, and I should be glad to know if any of the Delegates have met with a similar condition in their territories.

Many of our farmers recognise a condition in their cattle which they term "gallsickness" and which they attribute to the consumption of wilted grass. We have no evidence, however, that such wilted grass contains a toxin. Treatment of this condition with calomel and salts, followed by a few doses of nitro: muriatic acid, is apparently successful.

With regard to the outbreak referred to by Mr. Hornby, I would mention that natives have told me of similar experiences in this Colony. They have shewn me plants which were reputed to be poisonous, and which the local cattle did not eat, but they stated that if they brought cattle into that area from another area, where these plants did not exist, the imported cattle readily ate the plants and died.

The *dhoura* poisoning mentioned by Captain Jarvis, brought to mind similar cases which occurred among the horses of the 3rd Division in German East Africa, during the war. The horses belonging to one regiment were left for the greater part of a day to graze in a mtama (*dhoura*) shamba, and as they had been without sufficient food for some time, they readily ate the mtama which was about half grown. Next morning one of the Veterinary Officers reported that several of his animals were sick, and shewing peculiar symptoms. When I arrived on the scene, I found about 30 horses shewing brain symptoms, and death occurred within a few hours of the onset of the symptoms.

Mr. J. Walker: The Chairman has stated the position with regard to plant poison investigations of this Colony. Practically up to now, there has been little or nothing done, and it seems to me it is rather hopeless to attempt to elucidate plant poisoning, unless as Dr Viljoen has stated, experiments are carried out in the field.

I might mention that one disease has come under my observation, which occurs within a few miles of Nairobi: it is commonly known amongst the farmers as *Hæmaturia*. In this condition, there is often to be found on post-mortem, a large blood coagulum in the bladder. *Hæmaturia* is more or less constant, the animal loses condition,and the losses have been rather serious. A similar condition under the name of *Hæmaturia* has been described as occurring in Canada. I am inclined to think that it is due to plant poisoning, the toxin causing some changes in the walls of the blood vessels of the bladder, and allowing the blood to escape into the bladder. I think that if further investigations were carried out in the Colony, we would probably find some of the present unrecognised diseases due to plant poisoning.

Mr. H. E. Hornby: With reference to the Kaffir corn or "*Mtama*" poisoning, it is well known that at certain stages of its growth, the plant contains a cyanogenetic glucoside, but personally I have no knowledge of any definite cases of poisoning therefrom, although I have experimentally fed it at all stages of its

growth to cattle, and allowed cattle to graze freely in the gardens where the young plants were sprouting up from the old roots. I dare say such poisoning does occur occasionally, but the risks of allowing cattle free access to the plants are small.

Mr. F. J. McCall: In the Military during the war, at Dar-es-salaam, we fed up to about 25 pounds a day of green Mtama, chaffed and mixed up with other foods: we did not have any bad results, although I have observed horses, as a result of grazing in mtama patches, suffering from diarrhoea.

Mr. W. Kennedy: I would like to ask Dr. Viljoen whether he has ever noticed symptoms in horses that have been fed exclusively on mealies in South Africa. Some of our farmers claim that if horses are fed on mealies and grass only, they are, as a result, more prone to shy at anything strange on the road.

Major Paul Tissie: Two cases of poisoning in oxen were diagnosed by me; they were due to *Manioc*, from which the skin had not been removed: the chief symptom was haemoglobinuria.

Mr. J. A. Griffiths: We have many obscure cases every year, with varying symptoms, accompanied by gastro-enteritis, which are attributed to unknown poisonous plants. Recently we have had some cases in North Nyasa, where deaths are reported as the result of cattle eating the outer covering of *Mohogo*. Natives say this is a cause of death in cattle.

Mr. F. J. McCall: "*Mohogo*" Cassava or "*Manioc*" on the Coast Belt is one of the staple cattle foods; it is given out in quantities up to about 20 lbs a day. If fed to horses in other then small amounts say 3 lbs., it is apt to provoke colic.

Dr P. R. Viljoen: I have very little to say in reply to the discussion which has taken place. There appears to be some misconception regarding the toxic properties of the kaffir corn plant, or *Sorghum*. It is a generally accepted fact that this plant can, and does, produce poisoning in stock, but only under certain conditions, and one of these conditions is, that the plant is in the young growing stage, and, secondly, that some form of wilting, as a result of the heat of the sun, shall be present. I do not think that the plant has been shewn experimentally to be very toxic in South Africa, but as I mentioned before it is generally accepted to be so elsewhere.

With regard to the development of prussic acid in plants I might refer to our experience in the investigations into plant poisons, carried out mainly in connection with Lamziekte. We tested most of the plants and grasses on the Lamziekte areas, for the presence of the cyanogenetic glucoside, which is the precursor of prussic acid, and in some cases we found plants to contain a great deal. One grass in particular, was fed very extensively to experimental animals, but in no case could any symptoms be set up, although according to our tests it contained a great deal of poison.

With regard to the feeding of mealies exclusively to horses, I am afraid I have not had any experience similar to that described by Mr. Kennedy. Personally, I do not believe that there are any toxic properties in mealies, but that the symptoms may be attributed to digestive disturbances.

In concluding I cannot help referring to the excellent work done by Sir Arnold Theiler in connection with diseases set up by plant poisons. He has undoubtedly created an entirely new chapter on Animal Pathology by his discoveries in connection with the "incubation period," and fever reactions observed in some plant poisonings.

RESOLUTION.

Plant Poisoning.

This Conference records its appreciation of the work in South Africa upon poisonous plants, and considers that a Pan-African enquiry should be instituted into the distribution and effects of plants shown elsewhere to possess toxic properties.

A. SPECIFIC ANIMAL DISEASES.

(14) Ulcerative Lymphangitis.

Vet. Major P. Tissie (Chef du Laboratoire Veterinaire, Tananarive, Madagascar): The microbic or mycosic types of Lymphangitis, as compared with other non-microbic forms, are characterised by multiple abscesses, with or without cording of the lymphatics.

In Madagascar, we have Ulcerative Lymphangitis, due to the Bacillus Prieszi-Nocard, Sporotrichosis of the horse due to the *sporotrichum equi*, found in 1906 by Mr. Carougeau, and Streptothricosis is also met with. Epizootic Lymphangitis caused by the *cryptococcus of Rivolta*, has never been diagnosed on the Island.

(1) Sporotrichosis:—Affects horses, mules, but never donkeys or bovines.

This Sporotrichum is a parasitic fungus belonging to the group Mucedinae and is found in nature on vegetable debris, on thorns, on fruit, on flour, and on different types of grain.

Symptoms:—This disease is characterised by subcutaneous nodules, which are at first hard, and become gradually softer, forming abscesses; they are painless and are not accompanied with enlargement of neighbouring lymphatic glands. After abscess formation, these nodules leave ulcers which heal up spontaneously, but sometimes the nodules become encysted.

The nodules are most frequently found in regions well supplied with lymphatics, as on the limbs, perineum, scrotum, and the nasal mucous membrane, they may be grouped together in the same region or may be scattered about on different parts of the body. There is no fever.

Doctors Boucher and Carougeau, found a case on a horse in 1921, caused by the sporotrichum gongeroti with the following symptoms; exudation from the nostrils, and enlargement of the sub-maxillary glands, the exudate was yellowish white, thick and muco-purulent, ulcers were present on the septum nasi, the ulcers showed sharply defined edges, the glands were enlarged and hard, irregular not adhering to surrounding tissues, no lymphangitis was present.

Course:—The disease is usually contracted through sores, wounds from the harness or tick bites, due to the Amblyomma, the condition is only slightly contagious. One feels on palpation at first little round nodules in the subcutaneous tissue; these nodules are usually the size of lead pellets (small shot) to begin with. They increase in size slowly without any inflammation, until they become the size of a nut, and finally the nodule bursts and pus exudes; this pus is whitish in colour, thick and creamy, and sometimes blood stained. The opening of a lesion is followed by small ulcers 1 to 2 centimetres in diameter, covered over by a brownish red crust, which adheres to the surface. On pulling off this crust, a granulating ulcer with well defined borders is found: sometimes the ulcers have a violet tint, generally healing takes place without any difficulty. The course of the disease varies greatly in different cases, sometimes the body is rapidly covered with lesions, in which case the animal becomes weak, loss of condition is gradual and death supervenes.

Lesions:—The disease is characterised by subcutaneous nodules, which go through three stages, (1) hard nodules, (2) softening of the same, and (3) abscess formation. Sometimes the nodule encysts and becomes fibrous: one may find lesions on the eye-lids and conjunctivae. Ulcers, similar to those found in glanders, may be found on the nasal mucous membrane. Nodules also similar to those of glanders may affect the lung. Mr. Carougeau has never found abnormalities in the trachea, kidneys, liver or spleen.

Bacteriological Diagnosis:—Microscopic examination of the pus is not often positive, the presence of parasites in smears is very rare, one may, however, sometimes find huge, irregular, rod-shaped bacilli which are gram positive: giant cells are almost always found, but mycelium filaments are never present. In culture on Sabouraud's medium, either at room temperature, or in the incubator, growth takes place in 24 hours: the growth takes the form of thin filaments, and towards the fourth day, spores are formed on the ends of the filaments. On potatoes, the culture is sticky and greyish white in colour.

Intraperitoneal inoculations into guinea pigs produces an orchitis, which may disappear. In any case the testicles remain loose in their covering.

Diagnosis: At the beginning of the infection, diagnosis is easy, for the small shot feel, observed, on palpation is very characteristic: later the thickness of the pus may place the diagnosis in doubt, but cultures should clear up this point.

Prognosis: The prognosis is favourable since the specific treatment by potassium iodide has been found.

Treatment: The disease is not very contagious, but contact of healthy animals with infected ones should, however, be avoided. Great care should be taken to avoid infection of healthy horses through contaminated harness, stable utensils, etc. Prophylaxis consists in good hygiene, sound food, and turning animals out to grass. The treatment proper, consists of opening up and disinfection of the lesions, and internally potassium iodide in 20 gramme doses for 15 days or in other words 300 grammes for a course of treatment.

(2) ULCERATIVE LYMPHANGITIS.

This disease occurs frequently in Madagascar, and through the order of the 31st October 1918, the disease was added to the list of contagious diseases, implying compulsory notification, isolation of the infected, combined with other necessary sanitary measures. The disease has been diagnosed in several parts of the Island.

Pathology: This disease is transmitted by ticks, especially the *Amblyomma nebreum*, which are generally found on the inside of the thighs, scrotum and sheath. Cases occur in animals which are not properly groomed, as for instance horses working on road improvements, and native owned mares.

SYMPTOMS: Ulcerative Lymphangitis manifests itself by swellings, nodules, ulcers and cording of lymphatic vessels. The disease may be localised in a definite region, most frequently a limb; but through the carelessness of natives the infection usually becomes generalised, one then observes wide-spread pus formation gradually increasing, until the animal is transformed in to what one might call a pus factory. The limbs become infiltrated and hypertrophied. When big abscesses are forming a rise of temperature occurs.

LESIONS: On post-mortem, one notices numerous abscesses in the dermis, limbs affected for a long time are hypertrophied through the formation of lardaceous tissue, which on section exudes a yellowish fluid. Abscesses may be found involving the liver, the spleen, the kidneys, and the peritoneum.

BACTERIOLOGY: Smears from the pus, when examined under the microscope, show organisms, some of which are free between the pus cells, and others are found inside the leucocytes; the organisms sometimes appear as fairly thick bacilli, these are short with round ends. Sometimes cocco: bacilli are found. The organisms are easily stained by aniline dyes, and are gram positive. Cultures are easily obtained at room temperature and the organism grows well between 30 and 40 degrees Centigrade in peptonised broth. When infected pus is inoculated into the peritoneal cavity of guinea pigs, an acute orchitis follows with adhesion of the testicles to the scrotum. The orchitis appears three days after inoculation, and the animal dies within eight days. The pus obtained from this orchitis is not so thick as that obtained from a glanders orchitis. If instead of pus guinea pigs are inoculated intraperitoneally with a culture of this organism no orchitis follows.

PROGNOSIS: If treatment is adopted early the disease may be cured although sometimes relapses occur after apparent recovery accompanied with the formation of internal abscesses, resulting in death. When the limbs have become much enlarged, through the formation of lardaceous tissue no treatment can bring this back to normal.

TREATMENT: Prophylaxis is most important: thorough grooming of all equines in the country is essential. Contact between sick and healthy animals should be avoided as ulcerative lymphangitis is very contagious.

CURATIVE TREATMENT: (1) Evacuation of abscesses, (2) hot fomentations on the limbs, and (3) the use of mercurial ointment on the lesions may be tried. We have tried on one mare repeated massive inoculations (200 c.c. each time) with anti-streptococcic serum, or anti-diptheritic serum, but the good results were not permanent.

We have tried an iodised polyvalent vaccine containing streptococci, staphylococci and Priesz-Nocard bacilli; the results were satisfactory, but a relapse occurred two months afterwards.

A combination of pus and ether, made up as follows:— pus 2 cc. ether 5 c.c. distilled water 3 c.c. has also been tried. The dose given was 1 c.c. daily subcutaneously. Some good results were obtained amongst which is the cure of one horse that was heavily infected with the disease.

Treatment was also tried with cultures of Priesz-Nocard bacillus emulsified in saline, and killed at 70 degrees. Two horses were treated with daily injections of 5 c.c.; one heavily infected animal showed no improvement; the other one, in which severe lesions were present was cured in twelve days. We think that the latter vaccine could be used in the Colony, not as a curative, but as a preventive agent. The best treatment at present is, as in Epizootic Lymphangitis, intravenous inoculation of Neo-salvarsan, in doses as recommended by Veterinary Officer Deschjeaux: 1½ grammes daily for four consecutive days, then eight days rest, then doses of 1½ grammes daily for four days. If the animal begins to lose condition, or if the mucous membranes show icterus, treatment must be stopped to avoid poisoning. Deschjeaux advises the intravenous inoculation of 5 c.c. of renaleptine (synthetic adrenaline) 5 minutes before administration of Neo-salvarsan.

Intra-muscular injections of Neotrepol were tried in two mares without good results. Any systematic treatment must be accompanied by local treatment, viz., cauterization of abscesses, disinfection, etc.

In the *Journal of Comparative Pathology and Therapeutics*, No. 2, of June 30th, 1922, F. C. Minett states that he prepares an anti-toxic and anti-microbic serum by inoculating horses with bacilli killed by heat and ætherised alcohol. Minett's treatment has not yet been tried in Madagascar.

MR. W. KENNEDY: I am very grateful to Major Tissie for his introductory remarks on these diseases, and the description he has given of them as they occur in Madagascar.

Ulcerative Lymphangitis is a very serious equine disease in Kenya Colony and, during the year 1922, 130 cases were reported. Of these 130 animals, 46 were destroyed as incurable. Vaccine treatment was applied in many of these cases with beneficial results. The vaccine is produced at our Laboratory at Kabete, and Mr. Bradshaw will be able to give details of the type of vaccine used. In some cases cures were effected by surgical interference followed by the application of biniodide of mercury ointment, and the best results would appear to follow vaccine treatment combined with surgical treatment, and the application of biniodide of mercury.

We have suspected ticks in connection with the transmission of this disease in Kenya Colony, but we have no definite evidence implicating any particular tick; that is, no transmission experiments with ticks have been successful. It is generally believed in this Colony that the causal organism commonly gains entrance to the animal's body through tick bites, *i.e.* that the ulcers left by ticks of the amblyomma type appear to form a suitable nidus for the organism.

I should be glad if Major Tissie would be good enough to inform us if it has been definitely proved in Madagascar that Amblyomma hebreum can transmit the disease, *i.e.* is an actual carrier of the disease.

In treating Ulcerative Lymphangitis here relapses have frequently occurred, and it is generally assumed that the immunity conferred by the use of the vaccine is of a very temporary nature. The organism is, I think, widespread throughout the soil in this Colony. The disease is frequently found associated with a skin disease, which was first named Uasin Gishu skin disease, and is now known as Streptothricosis.

The frequency with which these two diseases have been found occurring in the same animal has given rise to an impression that the causal organisms are identical.

On farms where equines are regularly dipped it has been noticed that the incidence of the disease decreased; this also points to ticks being implicated in the transmission of the disease.

Captan R. H. Knowles: R. A. V. C. We all remember that Ulcerative Lymphangitis was a very important disease during the war both in France and Italy, and the number of cases ran into thousands. War conditions, of course, favoured the spread of the disease. Large numbers of the Veterinary Hospitals, where these horses were kept, became very contaminated with the Priesz-Nocard bacilli. This suggests one important point that we ought to remember, that is, we should always set apart a definite isolation ward or stables for cases of Ulcerative Lymphangitis.

In the Army a large number of cases were subjected to vaccine treatment. I had charge of the Bacteriological Laboratory in Italy, and had under my care about 150 cases of Ulcerative Lymphangitis. Vaccine treatment had been tried before, started I think by our Chairman, Mr. Montgomery, and by Truch and Watson in France, with a varying amount of success.

In Italy I prepared vaccine by the ethyl chloride method, which had then been recently introduced. Twelve strains of the Priesz-Nocard Bacilli, isolated from recent cases were employed. They were first grown on serum-agar and later on plain agar. The collected growth of the bacilli was then kept in contact with ethyl chloride for 48 hours at 0°C. to 4°C. After removing the ethyl chloride the bacillary mass was emulsified with saline solution and a preservative. Careful statistics were kept which I published in the Journal of Comparative Pathology in 1918. The percentage of cures was increased from 42% without vaccines to 82% with vaccines.

The question of the tendency to recur is very important. All the cases which were discharged from the Veterinary Hospital as cured by vaccine treatment were branded with a V on the left shoulder; these cases were kept under observation for at least six months, and some of them up to nine months, and unless they remained cured for a period of six months they were not included in the figure of 82% of cures. Thus whilst not claiming that this is a satisfactory treatment, it gave better results than any other form of treatment.

Another important thing we found was that the secondary abscesses which formed on the legs were in a large number of cases secondary infections with streptococci and staphylococci. These cases needed another vaccine against the specific infection.

Ulcerative Lymphangitis is a disease in which more harm than good can be done by vaccine treatment, if the dosage is not carefully regulated, as a negative phase is easily produced. The local treatment for these cases was simple surgical interference, opening the abscess and syringing with cusol, dressing with boric acid powder, and washing the legs down with creosol solution.

With regard to the simultaneous occurrence of Streptothricosis and Ulcerative Lymphangitis, I never saw a case of Streptothricosis in Italy, and in all the reports on Ulcerative Lymphangitis, including those from France by Watson, I never saw any reference to Streptothricosis occurring in the case of Ulcerative Lymphangitis. Mr. Kennedy referred to the fact that the immunity conferred by vaccine was not lasting. This was a point I also drew attention to in Italy. Although many of the cases of Ulcerative Lymphangitis were cured within three weeks or a month, it was always considered advisable to continue the doses of the vaccine for six weeks, in the hope that a more lasting immunity against the disease would be procured.

In conclusion I think that the following points should be carried out in the treatment of Ulcerative Lymphangitis:—

1. Vaccine should be employed,(2) Vaccine should be given as early as possible at the appearance of the first abscess. (3) Simple surgical treatment only should be carried out, (3) Strict isolation of cases of the disease to avoid contamination of the ground. (5) Concrete floors should be used in the stables where the cases are treated, so that efficient disinfection can be carried out and re-infection avoided.

Mr. W. KENNEDY: I omitted to mention in connection with the use of vaccine against this disease that our Chairman first produced a vaccine in this country 12 or 13 years ago.

Mr. H. E. HORNBY: I regret that Mr. Kennedy should have mentioned the possible identity of the organisms of Ulcerative Lymphangitis and "Streptothricosis" even though it were for the purpose of refuting the assumption. It is quite understandable that the presence of the lesions of "Streptothricosis" might make the penetration of the Preisz-Nocard bacillus easier, but it would be unfortunate if the idea were promulgated that we seriously considered the possibility of the identity of the two organisms. If it be proved that the lesions due to streptothrix may develop into a true lymphangitis, then this African disease of equines is not the true Ulcerative Lymphangitis which is known in Europe.

Mr. F. J. MCCALL: From Mr. Kennedy's remarks I gather that he wishes to emphasise not so much the identity as the co-existence of the two conditions as presented in almost all clinical cases which come under our observation in the field. I, however, would go further and would express the opinion that there is some very decided co-relationship between the two manifestations.

I have the greatest respect for the powers of observation of the Dutch Farmers on the Uasin Gishu Plateau, and many of these associate the presence of Ulcerative Lymphangitis in the horse and of Streptothricosis in the ox with the presence of Bont Ticks (*Amblyamma Variegatum.*) I have myself attended innumerable outbreaks of the disease, in which lymphangitis in the horse, Streptothricosis in the ox, and warty disease of the mouths and legs of Merino Sheep, occurred simultaneously. In this connection we know that the Streptothrix group are poly-morphic; abscess formation which is common in the horse, is more frequent in cattle and sheep. Surgically opened abscesses in all three in my experience almost invariably present as the feature of the slide, a claudius fast coccus, more rarely in addition to this coccus are also observed the typical bacilli grouped in the well known (*dropped matches*) formation. In the skin lesions the branched Streptothrix is the feature.

My experience leads me to believe that the organism responsible for Lymphangitis in Kenya is more or less facultative and ubiquitous as in the majority of cases outbreaks do not appear to be directly attributable to infection from antecedent cases. There is reason to believe that frequently the disease breaks out amongst mares and foals which are paddocked and have not been in contact with infected animals.

In certain typical cases the condition differs from the foregoing picture; sudden fever and the formation of a large abscess in the deep inguinal glands was in one case observed to usher in the disease; in others the animals died and the post-mortem revealed a large intestinal abscess or the presence of multiple abscesses in the liver and spleen.

The feature of the disease, however, is as a rule the insidious nature of its progress.

Pregnant mares in an acute advanced stage of the disease have given birth to apparently healthy foals. In some instances these have been reared and have remained healthy, in others, they have contracted the disease when six months old or more.

Treatment has been attempted with potassium iodide, with arsenic and with mercury: massive doses have failed as also have accumulative doses over long periods. At one time good results seemed to attend the administration of arsenic (30 grains) over 3 months, the improvement, however, was only temporary and out of over 100 cases observed no permanent cures can be remembered. Many alleged recoveries resulted, but almost invariably the animals ultimately succumbed to the disease or were destroyed. Vaccine treatment was attempted, but has not been successful or at least it has not been so in my experience, all my patients ultimately died. Apparent recoveries when traced subsequently in almost all cases which have come under my notice have finally died from the disease. It is claimed that the disease can be cured if the primary ulcers are treated surgically and cauterised. This, however, has not been my experience, probably because as a rule the condition was rather advanced before ulcer and abscess formation occurred; in cases in which the primary sore is distinct and which manifested no other constitutional infection, I do think that cautery with surgical and vaccine treatment should be beneficial.

I am of opinion that the disease is not the typical Ulcerative Lymphangitis described in Italy, France, and other countries. Certainly it has caused more deaths amongst equines, the property of settlers in Eastern Africa, than all other diseases combined, and to-day is the outstanding problem of horse owners.

Somali and Abyssinian ponies appear to be relatively resistent. I have known of many such animals, which although stabled alongside diseased South African animals failed to contract infection. I have never observed an advanced case in Abyssinian mules in which animals surgical treatment of primary sores usually results in recovery. Donkeys do not contract the disease naturally. It is realised that the foregoing remarks scarcely do full justice to the topic, but I think sufficient has been said to emphasise the importance of the subject and the desirability of further research into the whole problem.

The Chairman: We are deeply indebted to Major Tissie for introducing this subject, and those who have heard him will agree that the clinical picture which he has drawn is identical with that of the disease in Kenya outlined by Mr. Kennedy and Mr. McCall and that in Europe given by Captain Knowles.

When horses first came into East Africa they contracted Ulcerative Lymphangitis. As with Horse Sickness it appears that the infection pre-existed, and there is little doubt in my mind that the organism is a resident in the soil and further that it most frequently gains entrance into the horse through the wounds caused by ticks which are the most common cause of wound formation. The diagnosis by one who has seen the condition is not difficult, but an examination of smears from abscesses does not always show that picture of the organism which is regarded as characteristic of Priesz-Nocard. Cocci, diplo-cocci, and occasionally short, round-ended bacteria quite different from that sharp,square-ended typical arrangement of Priesz-Nocard, are often found but they are biologically identical and the organism is therefore particularly polymorphic.

We endeavoured many lines of treatment, and during the war had plenty of opportunities since Kabete Laboratory was used as a dump for all unwanted equines, serum both anti-toxic and anti-bacterial was prepared, and extensively employed, as well as vaccines made from cultures of Priesz-Nocard bacilli and we tried these products in various combinations. The impression given, and it would only be an impression when one is dealing with animals infected in such varying degrees, is that the autogenous vaccine gave the best results.

An attempt was also made to immunise horses considered clean, by the use of living cultures. These animals were put through a series of injections with live organisms until a point was reached when no reaction followed sub-cutaneous injections. They were afterwards placed in a district where disease was rife, and I believe they all contracted Lymphangitis.

I am sure Mr. Kennedy did not mean to convey the impression that in this country the streptothrix infection is the same as that due to Priesz-Nocard. The former is common in cattle, but, I have not found Priesz-Nocard in these animals.

In sheep as we well know caseous lymphadenitis is due to Priesz-Nocard, and that condition is common in East Africa. The lesions of Streptothrix in sheep are very serious and outstanding. A warty growth occurs round the muzzle on the ears and on the legs and feet. In horses and cattle the lesion is flattened. The scab is easily removable leaving the dermis raised, slightly moist and devoid of hæmorrhage. From the inside of this scab smears can be obtained showing cocci both Gram negative and Gram positive. They are usually arranged in parallel chains within a capsule.

Forms resembling true Streptothrix are also seen. This description applies equally to the one given by Van Saceghem for the Belgian Congo. There was no difficulty in obtaining pure cultures of the Streptothrix on ordinary agar, the growth closely resembling that of actinomyces, both bovine and human, and also that of madura foot in man. But from a large number of experiments carried out both with scabs and with cultures on sheep, cattle and horses, a number running into hundreds, only in one sheep did a small papule develop. As with Ulcerative Lymphangitis it does not seem that direct transmission from animal to animal occurs.

Mr. W. Kennedy has indicated that Ulcerative Lymhangitis is particularly widespread and it is clear that it lives in the soil in nature.

It was indicated to the Kenya Government that no good purpose could be served by placing it upon the list of contagious diseases. It was taken off, and has now again been gazetted, and I feel that the opinion of this Conference might be taken on the point as to whether or not, a disease occurring under such conditions as these, should be placed upon the schedule. If we had a reliable form of treatment conditions would be different. The general average of success in my own records was slightly under that of Captain Knowles, but I could not guarantee that these animals remained clear for six months as he remarked.

Mr. H. E. Hornby: My own reason for being emphatic on the non-identity of the two organisms is that you get the pure Ulcerative Lymphangitis outside of Africa without any question of "Streptothricosis," and you can get pure Streptothricosis, of Bovines at any rate, without any lesions suggestive of Lymphangitis. Nevertheless, the subject of "Streptothricosis" has only been imperfectly worked upon, and should be further investigated with a view to confirming the etiology which was worked out by M. Van Saceghem in the Congo, and independently by Mr. Reid of New Zealand, although the latter was unaware that the disease occurred in Africa. The question of the nature of the organism, whether it be a true Streptothrix, also calls for attention, and at the same time would be settled the question of what name is valid. At present the same disease is called by some "Streptothricosis", by others "Contagious Impetigo" and by yet others "Senkobo Skin Disease." I wrote to Brumpt of Paris for a ruling on the matter, and he stated that so far as he could judge from a limited amount of material the causal organism is a microbe and not a fungus at all.

Mr. J. Walker: It seems to me that the differential diagnosis of these various diseases might be made by a serum diagnosis test.

Mr. F. J. McCall: As representing the feelings of many owners, I agree that to have clinically infected animals ridden about the streets is dangerous.

Obviously, clinically infected beasts should not be allowed as we are increasing the risk of spreading the disease.

Mr. W. Kennedy: I do not know whether the Priesz-Nocard bacillus is common in South Africa or not, but I would mention that it is common in the South of Ireland where lesions in sheep are frequently noted. I have not heard of any cases of the disease occurring in horses in that area although horse breeding was carried out very extensively there.

Dr. P. R. Viljoen: As far as I am aware, Ulcerative Lymphangitis is not met with in the Union. Lesions produced by the Priesz-Nocard bacillus are fairly commonly seen in sheep.

A. SPECIFIC ANIMAL DISEASES.

(15) Swine Fever.

Mr. R. E. Montgomery: (Veterinary Adviser, Kenya, Tanganyika and Uganda): Referred to the greater virulence of the disease called Swine Fever in East Africa as compared to that of Europe, and the fact that pigs immune to the latter succumb to the East African form.

He considered it of great value if Delegates would collect suitable material for experimentation, and forward the same to the Kabete Laboratory. The most suitable material for preventing coagulation of virulent blood was a mixture composed of:— oxalate of potassium 5.0 grams; carbolic acid 5.0 grams; glycerine 1000.0 cc; and water 1000.0 cc. Equal parts of this mixture, and of blood will preserve the viruses of Swine Fever, Horse Sickness, Bluetongue etc.

Mr. W. Kennedy: Outbreaks of East African Swine Fever have occurred in this Colony in districts widely separated from each other, and, in most cases the infection has not been traceable to a previous outbreak.

This suggests the possibility of the existence of a reservoir. Bush pigs and Wart Hogs have been suspected of being carriers of this disease, but the results of a few experiments carried out at the Laboratory show that these animals do not remain infective for any length of time after inoculation.

Mr. J. A. Griffiths: In Nyasaland we have had some Swine Fever outbreaks in one district of the Protectorate, the Fort Manning district, for the past 12 years at least. The first outbreak was diagnosed in 1912, and the disease again came under notice in 1920, and in 1922. In the outbreaks which have been investigated there was a high percentage of mortality, which among European-owned pigs amounted to as much as 100%. The disease appeared to be quiescent in the periods between the outbreaks mentioned above, but it is possible it may have been smouldering among native-owned animals. European owners state that deaths have occurred among the bush pig, and also wart hog, and I have considered these to be a possible source of infection of the domestic pig.

Mr Hornby: In 1920 I investigated an outbreak of Swine Fever on the Nyasaland-Rhodesian border, and what I found there was reminiscent of the condition as I have known it in the Fort Jameson district of Northern Rhodesia. There the disease is always simmering, passing slowly round the district through a continuity of native-owned pigs. Mortality is high, but a few weaner pigs generally survive, and soon grow up and multiply to furnish fresh material for the disease when it again reaches the same district after a lapse of four or five years. Symptoms and lesions are essentially the same as those described by Mr. Montgomery in a recent publication on the disease as it occurs in East Africa.

Bush pigs are said to die in the immediate neighbourhood of a severe outbreak among domesticated pigs.

In Tanganyika Territory I lost some pigs from what was clinically Swine Fever, and these probably contracted it from bush pigs. On the other hand no dead bush pigs were found near this outbreak, but several healthy ones were shot.

A. SPECIFIC ANIMAL DISEASES.

(16) Rabies.

Mr. W. Kennedy: A form of rabies has been known in this country for the last eleven years. I think the first suspected cases of the disease occurred amongst jackals near Nairobi in 1912. Soon afterwards one or two cases came under notice in dogs, which had been bitten by rabid jackals. Some of these dogs were forwarded to Kabete Laboratory, and from them a definite diagnosis of rabies was established. In many cases natives had been bitten, but, as far as could be ascertained, no symptoms of hydrophobia developed.

A similar form of rabies is reported to occur on the West Coast, that is, a form in which natives who are bitten by rabid dogs do not develop hydrophobia; recently, however, a European was bitten in Senegal and died.

In this Colony we impose quarantine restrictions on all dogs imported from countries where the disease is known to exist.

The CHAIRMAN: The clinical symptoms shown by the dog which was first encountered showing this disease in Kenya towards the end of 1912, were those typical of dumb rabies. Inoculations were made into dogs, rabbits, sheep and cattle with brain material from this case, and symptoms of rabies and subsequent death followed in each instance.

Microscopical examination of the dog's brain also revealed the presence of Negri bodies. From this original case a strain was maintained at Kabete Laboratory for about nine months during which period other cases, diagnosed in a similar way, occurred among dogs and jackals in the neighbourhood. I know of two natives who were badly bitten by a dog subsequently definitely diagnosed as rabid, and neither of these manifested any symptoms in consequence. So far as I am aware no European was bitten, and in view of what has been said about the virulence of the disease in Senegal we must bear in mind the possibility that the effects of the bite of a rabid dog may not be the same on Europeans as on Africans.

Cases of hydrophobia among Europeans have occurred in Egypt and Sudan to the north of us, and in North-West Rhodesia to the south.

Mr. H. E. HORNBY: The Chairman has referred to the occurrence of two cases of hydrophobia among Europeans in North-West Rhodesia. In North-East Rhodesia canine rabies is common, and causes heavy mortality among native-owned dogs. I have known of many cases where European-owned dogs were bitten by such native dogs running amok, and in most cases hydrophobial symptoms developed after a minimal incubation period of fourteen days. Two cows were bitten on one occasion, and these both died. An observant farmer told me that he shot a leopard which was behaving in a strange manner in daylight, and after it had bitten one of his dogs. This dog soon afterwards died of rabies. I endeavoured to keep trace of three natives bitten by a rabid dog; two I know did not die; the third did, but I cannot say that it was from rabies. No cases of Europeans being bitten were brought to my notice during several years in North Rhodesia; but I remember, some years ago, attending in England the funeral of a man dead from rabies contracted on the West Coast of Africa. The possibility of the existence in the same country of two strains of virus, an exceedingly pathogenic one introduced from Europe, and a less pathogenic indigenous one, must not be overlooked.

Mr. J. A. GRIFFITHS: The medical records of Nyasaland show no cases of human hydrophobia, but that the canine disease exists was definitely shown by Garden in 1916 who undertook inoculations into rabbits. One European to my knowledge was badly bitten in the leg by a rabid dog. Surgical treatment was practised, and hydrophobia did not follow.

Mr. Hornby's experience in North Rhodesia is duplicated by mine in Nyasaland; this is, native dogs often go mad, and run amok, but that although other animals bitten by these may develop symptoms of rabies as early as fourteen days later, the natives themselves do not look upon the disease as communicable to man. Jackals have been known to become infected, and also to transmit infection to the dog.

Mr. F. J. MCCALL: The disease has not been diagnosed in Tanganyika Territory, but it would be unwise to say it did not exist.

Discussion then centred around the imposition of quarantine measures.

Captain B. A. JARVIS: Stated that no dogs were allowed into the Sudan except from a country declared free of rabies, and that dogs must enter by the Port Sudan route.

He referred to the systematic poisoning of stray dogs, which was conducted in the Sudan.

Other speakers referred to this matter, and the opinion seemed general that while such poisoning was sometimes necessary it should not be attained by broadcasting poisoned meat in places to which privately-owned dogs had access.

Mr. E. HUTCHINS: No cases of rabies have been diagnosed in Uganda, but its presence in canines has been suspected on two occasions.

Discussion then centred around the scarcity of Pasteur Institutes in Africa where Europeans could go for treatment after being bitten by mad dogs, and this is crystalised in the resolution which follows.

RESOLUTION.

RABIES.

That in the opinion of this Conference the disease discussed as Rabies shall continue to be regarded as true Rabies, and it draws the attention of the respective Governments to the inadequate facilities in many parts available for the Pasteurian treatment of patients.

(B) PATHOLOGICAL RESEARCH.

Mr. R. E. Montgomery (Chairman): It devolves upon me to open the subject of Pathological Research. It is a very big subject, and needless to say one can do little but open it for discussion.

The subsidiary headings of the Agenda are: (1) Dominant subjects in each country; (2) Co-ordination, preventing duplication; (3) Exchange of Reports and Memoranda, and another item, namely, "Microscopical Diagnosis." Laboratory and District Officers can hardly avoid reference here.

What appears to be research to-day becomes routine to-morrow; and what is the so-called "pure" research to-day becomes "applied" research in the future. So too, I would refer to the word "Pathological." Seriously that includes all aspects of disease; but in practice it is largely limited to enquiry into the causation and prevention of disease.

Again in connection with "Laboratories," we meet with every transition from the corner of the office where smears can just be examined, through a building set aside for the purpose wherein experiments are conducted and may be vaccines and sera are prepared, to an institution where not only is the work of the former performed on a large scale, but research of a more academic, and less realisable, nature is performed, and where too education is carried out.

Beyond these again come the final reference of a problem—say the identification of, or the effect of an organism—to a place, probably in Europe, where a truly expert opinion can be given.

Be these institutions what they may in wealth or equipment, they can only come in contact with the stock, through the agency of owners, Stock Inspectors, and Veterinary Officers doing field duty. It is the duty of these to filter the evidence or the material to avoid choking the Laboratory with unnecessary work.

Preliminary microscopical diagnoses are best conducted on the spot, as immediate action can then be taken. Enquiry concerning a disease *in loco* if thoroughly and scientifically made is Research of the first order, as it is upon the reliable history, epizootology, symptoms and naked-eye pathology that the Laboratory worker will hope to effect a short cut to the result instead of having to repeat or duplicate these observations.

With an understanding of our main diseases, a means of diagnosis and a means of prevention being available, enquiries become more and more necessary upon the spot, and under the natural conditions of the disease occurrence. Here again those of the field are able to render the most valuable assistance.

In these days of financial stringency in many countries it is necessary that the most important work be undertaken first. Now, the dominant diseases of each country can only be decided by the veterinary authorities there. However important foot and mouth disease may be in England, or lamsiekte in South Africa, they are not at present subjects of magnitude in Eastern Africa; nor is horse sickness or pleuro-pneumonia of immediately vital interest to England.

When agreed upon I suggest that the authorities in each territory advise those of others that certain lines of work are being undertaken. This naturally does not debar any Institution from confirming the work of another or of experimenting with the product of the second Laboratory before it ventures to apply the results in its own territory.

In your discussion I would ask you also to consider the possibility of applying this co-operation to vaccine and serum preparation. It would undoubtedly be very desirable that Institutions best adapted, best equipped and most suited should undertake the work for those countries less fortunately situated.

In the matter of exchange of Reports, we all know that considerable delay occurs between the submission of the typescript and the publication and circulation. I suggest that when passed for publication a copy may also be circulated on the library principle to other countries.

Dr. P. R. Viljoen: I think we have listened to a most interesting speech from our Chairman on the subject of Pathological Research. As somebody remarked the Chairman has covered practically everything, and I think most of us who have heard him are fully in agreement with most of what he has said.

We in the Union recognise very fully the need for field observations and for preliminary experiments being carried out *in loco*. Unfortunately such preliminary investigations also require special training, and with all due respect to the District Veterinary Officers, it sometimes happens that even they as trained Veterinarians have not had the necessary practice in scientific methods and find it difficult to carry out these preliminary investigations.

It has often occurred to me that it must be a waste of time and money to have to send a Research Officer perhaps 100 miles away to undertake preliminary observations, and investigations. I feel that the reason for this has to be looked for a great deal in the special training required for a Field Officer. I wish you to understand that this remark does not apply generally to all Veterinary Officers. You are all fully aware of the deficiency in our training in scientific research in European Colleges, and, unfortunately, it has not been possible in the past to allow

Veterinary Officers coming to this country from Europe to spend much of their time in the Laboratory in order to learn the ordinary methods of investigation This difficulty will be overcome in time, especially so as our future Veterinarians for the Union are now being trained in the country. Their training now includes the ordinary methods of investigation. During the course of their studies they have the advantages of living in an atmosphere where research work is being continually discussed and carried out.

The course of training extending as it does over at least five years leaves time for special training in this direction. I have no doubt, Mr. Chairman, that in the future there will have to be a certain amount of interchanging between the Laboratory and Field Officers, and this I consider very essential for the good work and co-operation of the whole profession in Government employ. The deficiencies which I have referred to can be overcome by the special training which Veterinary Officers can obtain, and the interchange of Officers referred to. The same remarks, to a slight extent only, I am pleased to say, apply to the microscopic diagnosis of smears, etc. Mr. Power has told us that in Natal the Field Officer now does his own smear diagnosis, and there is no question about it that this is the only satisfactory way, namely, the man on the spot is in the best position to make a definite diagnosis, but here again some of our older District Officers are not prepared to undertake this work. They are out of practice in this kind of work and, as some of them have informed me, it is not possible for them to do this work now.

The question of interchange of vaccines is also an important one. I cannot agree that the preparation of any particular vaccine can be allocated to a particular country until such time as the vaccine can be considered perfect. When one takes into consideration a vaccine such as Anthrax, we all realise that further improvements of not only the known vaccines, but of others, are extremely necessary. Now in the Union where Anthrax is such an important problem, we consider it one of our main duties to try and prepare the very best Anthrax vaccine that is possible for science to bring about. We for instance could not agree to leave off work on Anthrax vaccine if it were decided to allocate such work to another country. I merely mention this to show how difficult it is to allocate work of this nature. In other cases where vaccines are prepared according to well-known accepted methods I think that it is only right that one Laboratory should be asked to undertake the preparation thereof. For instance Pleuro-pneumonia or Rinderpest does not occur in the Union to-day, and if it did we would certainly knock at the door of the authorities in these territories for the necessary vaccine and serum.

With regard to the Chairman's remarks concerning the interchanging of Reports on diseases which are under investigation in different countries, I certainly think it would be a very good idea if this can be agreed to. It is certainly of great importance to the research worker if he knows what his colleagues are doing in the other territories. He may at any time require assistance from those colleagues, and as the position stands to-day he does not even know that somebody else is working on the same thing. I entirely concur with the remarks made by the Chairman. The interchange of Reports is an important matter, and I was certainly under the impression that this was going on satisfactorily. I quite agree that our discussions here have revealed the fact that we are not all *au fait* with the result of the work carried out in certain parts, so that there seems to be a need for tightening up the arrangements. I was very pleased to hear the Chairman's remarks on the extension of work in Pathological Laboratories. We at Onderstepoort try and collar as much as we can, even from other branches of science. Not that we are greedy, but because we find it absolutely necessary if progress is to be made in purely veterinary matters. You are all aware that we have Chemists, Entomologists, and Botanists attached to the Institution, and that the Bio-chemical section has developed enormously since it was commenced at Onderstepoort. There is an enormous amount of work to be done in this direction. We have also recently started research work in purely physiological matters, and before very long a Pharmacologist will be appointed to the staff of the Division, so that you will see that Onderstepoort, at any rate, does not only believe in a wider scope for Pathological Research, but is actually working in this direction. I feel quite sure that I am speaking for my Chief when I say that from us at any rate other territories can expect the fullest assistance in any matter appertaining to Veterinary or Pathological research.

Mr. W. Kennedy: In my opinion all field Veterinary Officers should be given facilities to take short courses of training at a Laboratory, if possible, in the country in which they are working. A Veterinary Officer in the field without a microscope is considerably handicapped and will frequently make mistakes in diagnosis or waste valuable time by forwarding materials to the Laboratory and awaiting a reply therefrom. The field staff should work in close co-operation with the laboratory staff and if this co-operation is not secured the efficiency of the Department will suffer.

The laboratory staff is dependent to a large extent on the field staff for the supply of material to enable it to carry out research in connection with particular diseases, and also for the application of any vaccines, etc., that may be produced.

Mr. W. M. Power: With regard to Mr. Kennedy's remarks and Dr. Viljoen's on this subject, is this inability of the field officer to carry out research work more due to lack of opportunity after they have qualified than lack of training? After

all it does not matter what training he has had during his college career if he is not in touch with research workers and remains for years on field work. There is a practical side to the question. I think the solution of the difficulty is in the closer co-operation between the field and laboratory worker.

Dr. P. R. Viljoen: I should like to amplify my remarks or perhaps correct the wrong impression that has perhaps been conveyed by my previous remarks. I meant to make it quite clear that there were two reasons why the older field officers find themselves unable to carry out research work when required. One reason I mentioned was that they do not receive sufficient training at the college and the other I meant to lay a good deal of stress on is that they have no opportunity in the field, and they get out of touch.

I firmly support the remarks made by Mr. Kennedy. I think our whole success depends entirely on very close co-operation between the two sets of workers. I mention further that to obtain this desirable result it would be a very good thing if the interchanging of field and laboratory officers were adopted.

Mr. F. J. McCall: I have listened with great interest to Dr. Viljoen's remarks. As our Chairman indicated, laboratories in small tropical African Dependencies are in many respects not altogether similar to large institutions such as Onderstepoort. From the remarks of most of the Delegates who have already spoken one would gather that in reality there were two distinct kinds of Veterinarians, Laboratory and Field Staff. We are peculiar in Tanganyika in that we have only one staff, and our whole endeavour is to avoid this distinction between field staff and laboratory staff. Field men come into the Laboratory, and in that way we promote union throughout the Department, the necessity for which seems to me too obvious to call for remark. We recognise that the head of the institute must necessarily remain for the most of his time in order to manage the laboratory, but in as far as his assistants and research officers are concerned, we arrange in as far as is possible that these shall be interchangeable. I think the benefits which accrue by reason of the more intimate touch with problems in the field such a system engenders more than compensates for any inconvenience which may arise through these interchanges. In fact I have always strongly objected to the terms laboratory and field staff. Even with the best intentions, if people do not mix and exchange views continually misunderstanding will occur.

Mr. Power lays stress on the importance of the administrative aspect of the question, and I certainly think there are more things in this world than can be seen through the eye-piece of a microscope.

Mr. J. Walker: I have listened with interest to the Chairman's remarks. To my mind a Veterinary Field Officer has little, if any, opportunity for carrying out field investigation or making observations in connection therewith, and I would suggest that this should be undertaken, when necessary, by a Laboratory Officer. Regarding the use of the microscope in the "field," in my opinion, this should be used as often as possible, the necessity for this is particularly indicated in Rinderpest immunisation operations where the virulent blood is collected from a beast born and reared on the estate on which the operations are being carried out. If the blood is not examined by the Veterinary Officer carrying out the operations and found to be free of other infections, prior to use, there is a risk of serious accidents occurring.

With regard to the interchanging of vaccines and serum, I am not quite in agreement with the views of the Chairman. We know that vaccines have been forwarded to Colonies from other countries; they have been tested as to their protective properties and found to be of no value. There is a possibility of vaccines undergoing changes during transit and I fail to see how some vaccines can be transported over great distances. As Dr. Viljoen has said, the preparation of vaccines necessitates more or less contant research work being carried out. There is a possibility of a shortage occurring in this or other countries in which case it might be impossible at some time or other to issue the requirements of other Colonies.

With regard to the interchanging of reports, I quite agree that this is most important. I do not think any difficulty is experienced in this respect, and, as far as I am aware, no difficulty occurs in obtaining reports from any Research or Veterinary Institutes in the various Colonies.

With regard to co-operation in Veterinary Research work, I think that each Colony should know its own needs. A line of Research work which may be required in connection with a certain disease in one Colony may not be necessary or even applicable in another. I think that each of the various Laboratories and Rearch Institutions should work out its own destiny.

Mr. H. Brassey Edwards: As the Senior Field Officer in Kenya Colony I think it should be imperative on this Government to see that every field Officer should have an opportunity of spending a short period at the Laboratory at Kabete. In a country like East Africa, where observations of disease are constant, with the result that the views on any particular disease may be altered frequently within a short while, it seems to me necessary that the monthly reports, (which the field Officers are expected to send,) should also be sent by the Laboratory Staffs, in order that field Officers may obtain information as soon as possible of these new researches. I have had the experience of going to farms where European Settlers have spoken to me of something new in local veterinary research about which I knew nothing myself.

The CHAIRMAN: In winding up the debate, I feel I am expresing the opinion of all when I say that the discussion has been unanimous that there shall be a close co-operation between the Veterinarians engaged in one branch and those engaged in the other—they are not two distinct species of Veterinarians—but the greatest difficulty is how to bring this into operation. It has not been suggested that the Laboratory men should go out into the field and do district work, but the bias has been the other way, that the field man should go to the Laboratory; a little of both would seem to be desirable especially during a man's earlier years in the service He can then be nominated, or nominate himself to whichever activity he should go in for, but only after a fair number of years, in which he can view the whole situation of Veterinary activities. There will have to remain, as Mr. McCall pointed out, one or more, permanently at the Laboratory to keep it running, but below those ranks a much freer interchange is indicated.

I put the period of laboratory experience at six months, because anything less than that is too frequently spent in satisfying curiosity.

The divergency of opinion in this Conference comes out on the question of co-operation in Research Work and in exchange of vaccine. We are all perfectly well agreed that there will be enormous difficulties in the allocation of tasks, and I do not see how that difficulty can be overcome at the present moment. By frequent discussions and exchange of ideas some medium way should be found. I, naturally, was not referring to vaccines unexploited, or where there is any experimental work remaining to be done, but to the stock products of an institution. It might for example be undesirable for Uganda to undertake the manufacture of Rinderpest serum or Pleuro-pneumonia vaccine, but such a task might well devolve upon an Institution where it has been produced successfully for a number of years, and the value of which is known. Where there is a doubt as to results naturally each country would continue its own observations, but where the success of the substance is demonstrated, there, if possible, some closer form of co-operation in vaccine production might be considered.

I agree with Mr. Walker, that reports are obtainable, but valuable time could be saved by not having to wait for delayed reports. I absolutely agree with Mr. Hornby. He spoke on applied science and pure science; however much the applied worker may have to put his nose to the grindstone, he must be allowed some latitude, some facilities for higher thought and study; it is the only way in which good applied work can be achieved.

RESOLUTION.

This Conference is of opinion that Veterinary Officers attached to a Government service should undergo a period of training at a Laboratory for a period of not less than six months during his probationary period and again as frequently as possible during his service, in order that the affinity between field and laboratory observations may be closer.

C. DISEASE CONTROL.

(1) Administrative System.

Captain B. A. JARVIS, R.A.V.C. (*Senior Veterinary Inspector, Sudan*).

In dealing with Administration, I propose firstly to explain in a few words the Administrative system of the Sudan Veterinary Service and work accomplished, and afterwards to touch very briefly on one or two other matters which may be of interest to the Delegates in opening up a field for discussion for increasing the scope of operations of a Veterinary Service in any country.

The Staff in the Sudan at present consists of one Director, Assistant Director, one Veterinary Bacteriologist, and fourteen British Veterinary Officers. In addition to this we have seventeen Egyptian Veterinary Officers. All the British Veterinary Officers are seconded from the Royal Army Veterinary Corps to the Egyptian Army for a tour of service ranging from a two year contract to a maximum of ten years, after which service they revert back to the Corps.

There are fifteen Provinces in the Sudan of which four have no resident British Veterinary Officers, but tours of inspection are arranged from time to time as necessity arises. The total area of the Sudan is 1,014,600 square miles. Our second largest Province, and a very important one from a Veterinary point of view is Kordofan, which has an area of 119,000 square miles. Taking into consideration this vast area, and the fact that in the majority of cases long distances have to be covered principally by camel treking, it can be readily understood the difficulties we have in coping with outbreaks of disease.

Regarding the control of the Department, it is a distinct Department, and directly responsible to the Central Government for all matters appertaining to Veterinary organisation, including a Breeding section, Dairy Section, export of hides and skins etc.

The Director is also a member of the Commercial Intelligence Branch of the Central Economic Board.

The export of cattle and sheep to Egypt is a valuable asset to the Sudan, and brings in a considerable revenue to the Central Government.

This trade, I may say, was inaugurated and developed by the Veterinary Department, and from the year 1913 to 1923 over 1½ million cattle and sheep have been exported from the Sudan. The principle supply of meat for the troops in the Middle East during the war was obtained from the Sudan. I might also add in this respect that in one of our best export years *i.e.* 1918, the total value of exports of Cattle, Sheep, Goats, untanned Hides and Skins from the Sudan amounted to £1,375, 556. It is most interesting to compare this figure with that for the year 1907 when the total value of exports of the same commodities valued only £31,680. By this, I think you will agree what a vast importance a Veterinary Service has in developing a country.

The appointment of a Veterinary Bacteriologist was made in 1921, and the Laboratory is well equipped, and it is hoped, as funds become available, to develop the research division of the Veterinary Department.

I would now like to emphasise how important it is that Veterinary activities in all countries should be controlled by the Veterinary Service alone.

My reasons are: Firstly, that Veterinary Officers by their training and experience are obviously fitted for this work. Secondly, the Veterinary Services are constantly in touch with the animal population and their owners, in connection with the controlling of disease, and thus are in a position to advise the Authorities on any question which may arise in connection with the Economics of Stock and animal products *i.e.* Breeding operations, Dairy produce, Wool, Hides and Skins etc.

A light reference might here be made to the training and qualifications of Veterinary Officers in tropical climates, and the following suggestions are put forward for consideration.

1. All Candidates for appointment in any Veterinary Service in the Colonies should be selected by a Board including in its members at least one Senior Veterinary Officer of the country to which he is to be appointed, if any such Officer be on leave at the time.

2. Candidates should be under the age of thirty years, and should be unmarried on first appointment.

3. Before taking up any field Veterinary duties newly appointed Officers should be attached to the nearest Veterinary Laboratory for three months or preferably six, and that during this period he must study the language and local conditions.

4. After a probationary period, if an Officer is found to be suitable, further facilities should be granted him for special Post Graduate study.

A general discussion then took place in which all Delegates participated, (Dr. Viljoen, Mr. W. M. Power, Major Tissie and Dr. Botelho were not present) and it transpired that Nyasaland and Kenya were the only Crown Colonies represented in which the Veterinary organisation is not autonomous.

In view of the very definite recommendations on the staffing of the Veterinary Service in the Colonies embodied in the Report of the Committee which was appointed by the Secretary of State for the Colonies in 1920, it is considered in the best interests of the Live Stock Industry that the recommendations of the above mentioned Committee in this connection should be given effect to in countries where this has not already been done.

The justification of these recommendations has been amply demonstrated by the success which has elsewhere attended the efforts of Veterinary Administrations enjoying complete autonomy.

It is also considered that the Head of a Veterinary Organisation should be accorded similar rights and privileges to those enjoyed by Heads of other Departments, and that the salaries of Veterinary Officers should be as formerly, on the same scale as that of Medical Officers. This is highly desirable in view of the necessity of attracting the most suitable class of candidate for the Colonial Service.

It was agreed that the selection, appointment and training of Veterinary Officers for the Colonial Service should be on the lines suggested by Captain Jarvis.

(C) DISEASE CONTROL.

(2) Use of Natives for Intelligence Purposes.

Mr. J. A. Griffiths (Chief Veterinary Officer, Nyasaland): The value of the use of native owners for intelligence purposes in the detection of disease varies considerably. I consider that they are usually unreliable. Mr. McCall has stated, under another heading, that native owners who own large herds are more likely to be reliable in giving authentic information of the outbreak of a disease in their cattle and this is my experience. I think, however, that Mr. Brassey Edwards struck at the root of the subject when he stated that it is essential for a Veterinary Officer to gain the confidence of the owners and headmen in Native Reserves. In fact it should not be necessary to state that with all owners, whether Native or European, the Veterinarian must first have their confidence before he can expect to have the measures he proposes, for dealing with the disease in hand, carried out.

Mr. H. E. Hornby: My experience has been largely in the training of natives along the lines to which Mr. McCall has referred. White supervision of such Guards in the field is essential and with such, the native is very useful; given too much authority, however, he is a menace.

Mr. J. A. Griffiths: In Nyasaland, Village Headmen and Chiefs of districts are legally responsible in native areas for reporting disease or deaths among animals but I do not think that much reliance can be attached to this legislation in the control of disease. We find it better to employ trained natives either under the guise of Veterinary Police in native areas or as dressers in the areas of European settlement to detect disease outbreaks. These natives are trained by the District Veterinary Officers under whom they work at first directly. It is not at all difficult to train natives as inoculators, and in all the minor technique to permit of diagnosis being carried out or confirmed by the District Veterinary Officer. The class of native we use for preference are those who can read and write either English or the official language, Chinyanga. A large proportion of candidates are found to be unsuitable, and with all of them a long period of practical training is required.

I consider that the feeling of this Conference is that the use of trained natives is undoubtedly of value, if properly supervised.

(C) DISEASE CONTROL.

3. Legislation and Punishments.

This subject was briefly introduced by Mr. W. Kennedy, (Chief Veterinary Officer, Kenya Colony) who pointed out that legislation had been discussed in connection with each disease included in the Agenda.

The question of punishments, therefore, remained only to be dealt with.

A general discussion on this important subject took place, and opinion was unanimous that the illicit movement of diseased animals is a very grave menace, but that no resolution should be put forward for consideration particularly as in the case of Pleuro-pneumonia and Rinderpest the resolutions on these subjects would appear to cover all outstanding difficulties.

(D) GRAZING AND WATER FACILITIES.

Mr. W. Kennedy: (Chief Veterinary Officer, Kenya Colony.)

The great importance of this subject in all Stock countries will readily be admitted. The stock carrying capacity of a country under natural conditions, is governed by the rainfall, temperature, the presence or absence of permanent streams, richness or poverty of the soil, and, particularly in Eastern Africa, the distribution of Tsetse flies. In some areas the presence of thick impenetrable bush or jungle is another factor. The quality of the herbage, under natural conditions, depends mainly on the nature of the soil and on the rainfall, and, in this Colony, is adversely affected by grass fires. Our natives burn the grass off once and frequently twice a year, I think it is now generally admitted that this practice leads to the disappearance of the finer grasses in the pasture, and their replacement by coarse herbage. Another bad effect of grass fires is the resulting soil erosion which occurs. The grass is burnt off at the end of the dry season and the heavy rains which supervene wash away a considerable amount of the surface soil. Against these bad effects it should be recorded that, in this Colony, grass fires have a considerable effect in controlling the incidence of ticks, particularly in areas where the soil does not crack badly during the dry season. Further, grass fires have a sterilizing effect on the soil and this should be remembered in the cases of such diseases as Anthrax, Blackquarter, Contagious Abortion, and, I think, Ulcerative Lymphangitis. We therefore cannot say that grass fires are entirely harmful and we must admit that some of the effects are beneficial from a Veterinary point of view.

In this Colony, the grazing and water facilities, in certain areas, have to a considerable extent determined the habits of the natives occupying them. Thus we find in our highland areas that the presence of good soil associated with a plentiful rainfall and the presence of permanent streams has induced the natives to settle down and indulge in mixed farming. In other areas where the soil is poor and the rainfall scanty, we find purely pastoral tribes, generally of nomadic habit. The varying conditions met with have an important bearing on the question of disease control. Disease occurring in the highland areas, where the inhabitants are more or less stationary, is more easily dealt with, than in areas less favoured from the point of view of water and grazing: quarantine restrictions can be imposed, and herds of infected cattle can be segregated for considerable periods in comparatively small areas. In the drier regions, however, great difficulties are experienced in controlling outbreaks of disease; the water holes or wells, are few and far between, large numbers of cattle congregate at these points and move over vast areas in search of grazing. It will be readily seen, therefore, that in such areas, when diseases such as Rinderpest or Pleuro-pneumonia appear their control presents a very difficult problem, the disease spreads rapidly, and, owing to the lack of grazing and of water it is impossible to impose strict quarantine. If cattle movement were restricted in an area such as I refer to the losses from starvation would be greater than those caused by disease.

In our coastal area the grazing areas are considerably restricted by the presence of thick bush and tsetse flies, but in spite of this, large herds of cattle are to be found in some of the districts.

I might mention that the conditions that obtain in some of our desert areas, have resulted in the evolution of a type of cattle which might be described as "drought resistant." The conditions under which these cattle exist, however, preclude any hope of improving the breed in the immediate future by the use of imported bulls. The difficulties arising in connection with cattle dipping in desert areas will be readily appreciated. I might mention that the meteorological records of this country show a rainfall varying from 15 inches to 70 inches per annum, but there are no meteorological stations in parts of the Northern Frontier District, where the rainfall can only be described as extremely scanty. We have two fairly definite rainy seasons, one in April, May and June, and the other in October and November.

In the Masai Reserve there is a scarcity of water but grazing facilities are generally good throughout the whole Reserve. Owing to the absence of permanent water in certain areas, the carrying capacity of the whole Reserve is estimated at one beast per 10 acres, and it has been estimated that, if water facilities were provided in areas where they are lacking at present, the carrying capacity would be at least doubled. An effort to conserve water in the Masai Reserve by means of earth dams has been made by Government on a small scale, but the results have not been markedly successful. Boring and well digging have however, been carried out in at least one area, adjacent to the Masai Reserve, with good results. I trust that I have said enough to emphasise the urgent necessity for the provision of adequate water facilities in areas where these do not already exist.

I do not propose to deal with the question of artificially improving our grazing areas, because, in this Colony we are, I think, quite satisfied at the moment with the grasses we have. The growing of lucerne and of green crops for ensilage are however matters deserving the close attention of all dairy farmers.

Mr. F. J. McCall: Mr. Kennedy raised the subject of grass fires; this matter has received attention and legislation has been enacted in Tanganyika, not so much with a view to improving the grazing as to tsetse-fly destruction. In many of our tsetse areas instructions have gone forth that grass burning shall be stopped for a whole year in order to encourage a heavy growth and this will be fired simultaneously over a large section of the country at the height of the dry season; results are not yet to hand, but I think the matter is a very important one. In the Arusha and Kilimanjaro areas of the Masai Reserve, water conservation is receiving attention and already several dams have been constructed, and water furrows some of them 25 miles in length have been constructed; this work in Tanganyika is carried out by the local native administration in collaboration and conjunction with the Veterinary Officers and Stock Inspectors.

Captain B. A. Jarvis (R.A.V.C.): I think the question of grazing and water facilities is most important, and is of great importance to us in the Sudan.

The waterless tracts of country that have to be traversed by cattle coming to the rail-head for export, makes movement very difficult in the hot weather. In the Western district there are a certain number of wells, and new wells and bore holes are being dug at suitable distances with a view to improving the watering facilities.

There is a big scheme now on hand on the Blue Nile at a place called Makwar, where a dam is in the course of construction. By means of this an area of about 200,000 acres will be brought under irrigation for the purpose of growing cotton etc. And I have no doubt that in the future a lot of cattle and sheep will be reared in this area. Certain experiments on a small scale have been carried out in our breeding section to further the improvement of sheep in the Sudan by the introduction of a breed from Egypt.

It is hoped to employ these graded sheep in the improvement of the native sheep in the large irrigated area which will be under cultivation on the completion of the Makwar dam.

Mr. E. Hutchins: In many parts of Uganda around the Lakes, and on some of the rivers, particularly in the Western Province, many of the most valuable permanent water supplies are infested with tsetse-fly, *Glossina palpalis* in some areas and *Glossina morsitans* in others; there is not a very heavy infestation, but it is sufficient to render a great deal of otherwise very valuable grass country quite unsafe for stock.

RESOLUTION.

Grazing and Water Facilities for Live Stock.

This Conference is of opinion that funds should be allocated annually, in countries where considered necessary, for the provision of better watering facilities for live stock. This is desirable in order to control undue movement of animals and the consequent spread of disease.

(E) STOCK EMPROVEMENT.

Eugenics and selection and Registration of Sires.

Mr. A. G. Doherty (Deputy Chief Veterinary Officer, Kenya Colony): Eugenics as applied to stock in native reserves in this Colony is still an unopened book. There is no reason to believe that the vast flocks and herds have altered in the slightest degree in any respect, except perhaps in numbers, down the ages.

The science of the early British breeders who evolved our present-day improved types is capable of application to the native stock in Africa. The fact that the work is carried out in the 20th Century instead of the 18th gives us the benefit of the experience of the early breeders in dealing with the problems that present themselves. The subject provides unlimited material for discussion. With a long experience of the stock of the Native Reserves of East Africa I will endeavour to indicate the most profitable points for debate taking cattle as a basis.

The cattle of the Colony may, broadly speaking, be divided into two groups: (1) Herds in the settled areas; (2) herds in the native reserves.

(1) Amongst the first class improvement of type is largely a question for the owners themselves to be settled according to the requirements of the district and quality of pasture.

It is about twenty years ago that a few bulls were imported from overseas to make the experiment of introducing foreign blood to the native breeds. The result of these importations is well illustrated in the photographs of grade Shorthorns, Hereford, Ayrshire and Guernsey cattle I have laid on the table. The calves of native cows by these imported bulls grew out until they were quite unrecognisable as the offspring of their dams. The zebu hump was lost and quarters straightened out. Increased size and a more level top line were most noticeable.

I do not wish it to be supposed that the graded animals represented in attached photographs were bred at random, and that the produce of any native cow by any imported bull raised on any pasture in the Colony will come up to this standard. The cattle in question were bred from selected native cows by selected imported bulls on a pasture and under conditions best calculated to suit this class of animal. There are large areas in the Colony suitable for such grading.

2. Native herds comprise a number of different types of the Zebu species. Deterioration in size and conformation as a result of many adverse conditions, chiefly bad management, is very evident in all native reserves. The types of native cattle are distinct: just as distinct as our better known European breeds but without the fixed colour and breed characteristics of the improved Hereford or Polled Angus for example. There is, however, just as much difference in appearance between the cattle from the low lying, hot, dry plains of Jubaland, and the cattle of the high, cold, wet Nandi country as there is between a Guernsey and an Ayrshire.

In the main native cattle may be said to conform to the Zebu type the chief characteristics of which are the hump on the withers, drooping quarters and large loose folds of skin at the dewlap and navel.

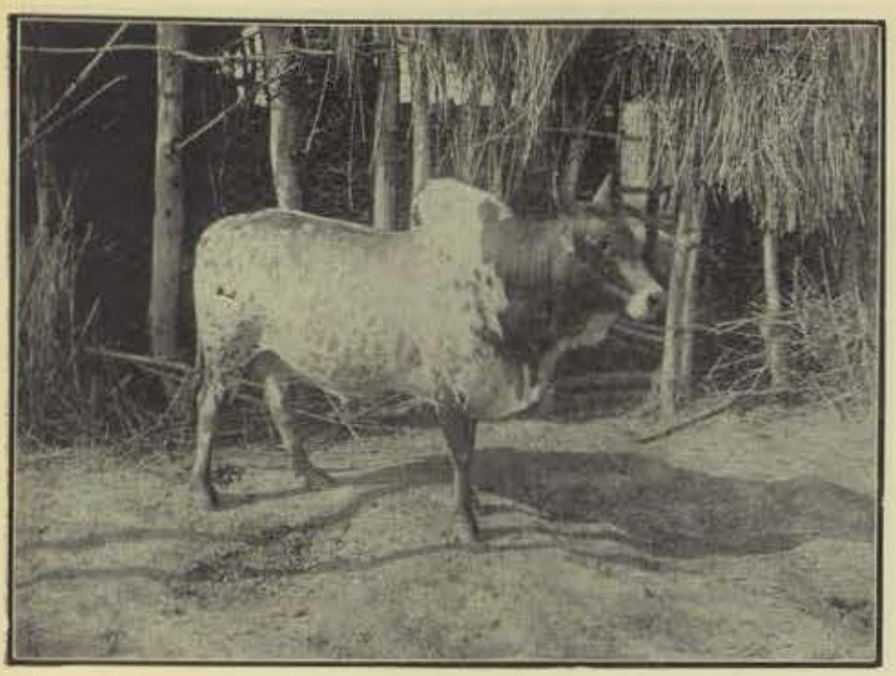
Past work on the improvement of the native type at once involved the use of imported sires. While imported blood is undoubtedly necessary to quickly attain certain qualities under suitable conditions, there are types of country that do not call for any crosses of foreign strains on the cattle supported on it.

There are for purposes of easy comparison two classes of native owned stock and pasture claiming attention. 1. Cattle of nomad pastoral tribes whose country has a small normal rainfall with few or no rivers and water facilities such as to involve increasing distances between pasture and water in the dry seasons. 2. The other extreme is cattle in the richer districts with permanent well watered grazing grounds and a good normal rainfall.

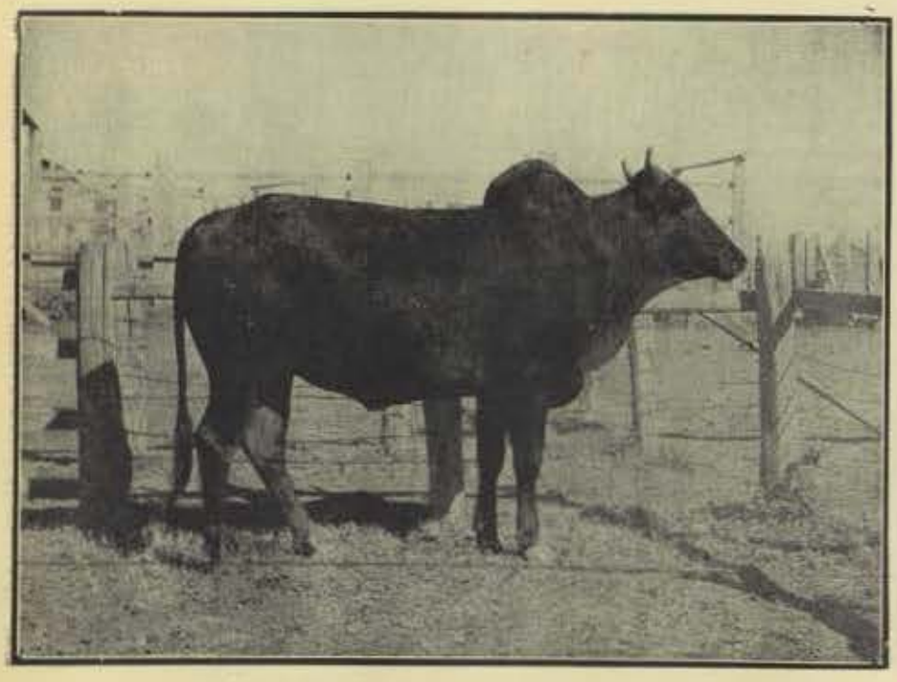
1. To obtain lasting improvement amongst cattle of the former class *i.e.* cattle found in dry country of small rainfall by introducing blood of breeds accustomed to ideal conditions of water and pasture, would not appear to be indicated unless preparations were in train to so alter the local conditions as to make them congenial to the new type of animal to be evolved.

2. The other extreme presents a very different picture, and the question of raising the standard of herds on richer well watered country is one which demands consideration on very different lines to the foregoing. Here we have pasture that will carry cattle of imported strains to develop herds for milk or to be used as fattening land to the requirements of the Colony. With the experience gained in the settled areas, there is no doubt that the native cattle are peculiarly responsive to modern methods of management and breeding. To maintain any improvement effected, however, calls for a proper balance between the improvement aimed at, the type of pasture and water facilities available and the idiosyncrasies of the native owner. These are the three essentials applying to the eugenics of our millions of backward native stock.

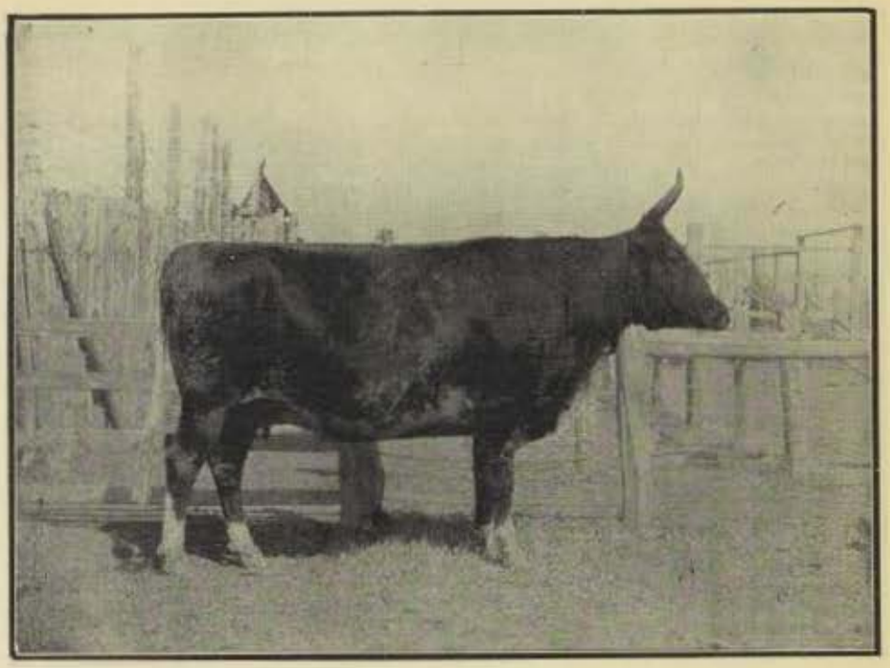
It is just recently that any work on this subject amongst native owned cattle has been discussed. A beginning is now made possible in the Masai Reserve, by sanction having been obtained, to a suggestion made, to utilise cattle obtained as



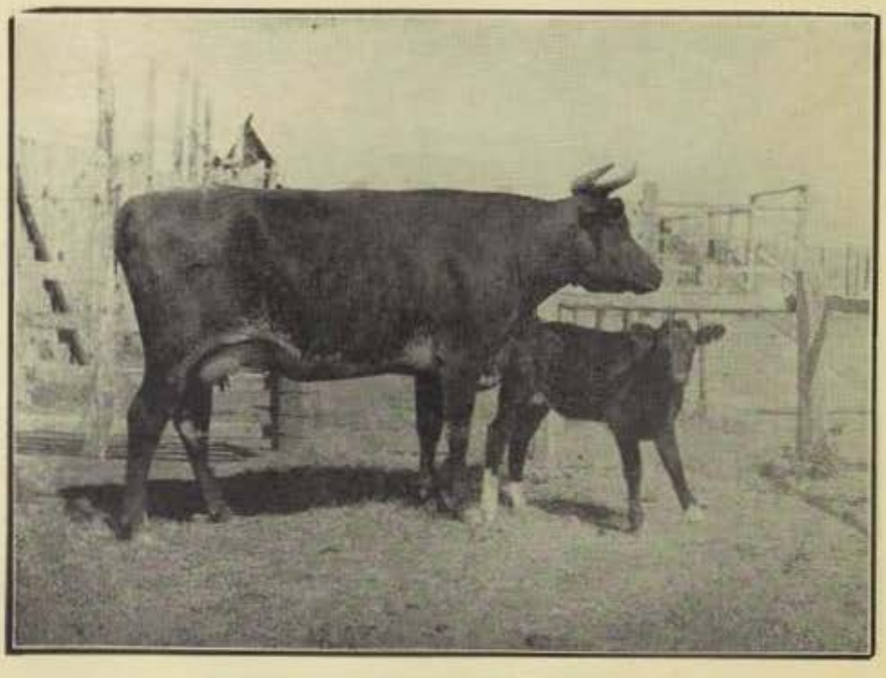
NATIVE BULL.



NATIVE HEIFER.



FIRST CROSS GUERNSEY SECOND CROSS SHORTHORN ON NATIVE COW.



TWO CROSSES SHORTHORN BLOOD ON NATIVE COW. CALF THIRD CROSS SHORTHORN.

payment of fines inflicted on native tribes: 50% of the cattle involved are to be female stock which will form a basis of permanent herds in the Reserves to be used for demonstrating improved methods of cattle husbandry to natives.

Major Hemsted, the Officer administering the territory occupied by the Masai, is a strong supporter of this organisation. An extract from correspondence with him is as follows:—

> "My idea would be to have a Stud Farm in each Native Reserve where selected native stock can be run under conditions to which they are accustomed and careful attention given to breeding. There is no reason why such farms should not be self-supporting or even revenue producing. They need not be run on expensive lines and fine cattle as you suggest might form the nucleus of the herds. The sale of surplus cattle and ghee should provide the necessary funds."

It is hoped that this scheme will be successful and that it will develop into an organisation capable of directing the work of stock improvement in the proper channels. The financial side of such a system should appeal to Government and surpluses will be available for the purchase of bulls which are readily obtainable in the settled areas.

The opportunities that exist, under such conditions as I have outlined, for research into the important question of breeding the most efficient types of stock for the country as a whole will be great and should prove of incalculable benefit to the cattle industry.

The subject under discussion as affecting small stock need not take up any time in the opening of this debate. The question of increasing size and constitution in goat and sheep flocks is, I know one in which the C. V. O. from Tanganyika Territory is interested, and he possesses an intimate knowledge of the possibilities and benefits of better conditions.

The pig industry has received much attention in the settled areas and pigs of any of the improved breeds do well under efficient management.

Registration of Sires.—This question goes hand in hand with any organisation as outlined in my remarks on Eugenics. A system of registration similar to the registration scheme under the breeding organisation in Ireland would appear to be indicated in the first instance *i.e.* registration of females to be served by approved sires

Mr. F. J. McCall: Of the truth of the views expressed by Mr. Doherty in his opening address on this subject, I think there can be no doubt. It is, however, like many other problems dealing with the native question, one in which it behoves us to hasten gently. As it affects Tanganyika we have made a start in a small way by importing a few pedigree Ayrshires and a Friesland Bull.

The formation of two Zebu native herds has also been laid by the purchase of selected animals of the desired type and I feel confident that much valuable work in this direction can be accomplished, especially if rigorous casting of all unsuitable animals amongst the increase is persisted in, and if milk records are carefully kept. Any observer intimately acquainted with the country must have been impressed with the exceptionally good type of native animal that is encountered from time to time.

Obviously Masailand and similar arid areas are unsuited for dairy breeds, but the introduction of cattle of a hardy beef type like the red North Devon, the polled Angus or even the Afrikander would appear to be indicated; on the other hand high veld districts like Iringa, Arusha and Rungwe, with perennial streams and green pastures, are eminently adapted to strains of dairy cattle, such as grade Kerry, Ayrshire, Guernsey or Friesland. It may be desirable, or even necessary, to evolve a type or types of animals suited to the peculiar environments encountered in various districts of the territory. The possibility of improving the local animal by selection along special lines or even the introduction of the better class Zebu of India are all points worthy of careful consideration.

The important factors to bear in mind in arriving at a decison with regard to the advisability or otherwise of modifying the local breed by introducing grade stock into any given district are: (1) the character of the grazing and the soil; (2) the nature of the climate, especially with regard to the duration of the dry season; and (3) the incidence of disease.

The prevalence of thorns, dense bush, burrs and various species of spear grass precludes the possibility of introducing wooled sheep in some districts in Tanganyika but it would seem that mutton breeds such as karakul would greatly improve the local flocks of these areas.

There are, however, many districts *e.g.* Tabora, Shinyanga and Mwanza, which are eminently suited for the wooled animal. Sheep today are worth 2/- per head locally, and the skin is unsaleable. The coarse wool of even the common European mountain sheep to-day is worth about 9d per lb. and an average sheep shears 4 lbs while the skin is a saleable article, and I think it is quite possible in Tanganyika to grade up a better type of wool than this. The value if such an innovation were to succeed is apparent, and there is no reason why it should fail on well drained gravel plains such as those met with in the sandy (granitic gneiss) country referred to.

In a similar manner the introduction of a suitable type of goat might exert a most beneficial influence on the native animal which is small, weedy and seldom yields a carcase of more than 18 to 20 lbs. The cleaned carcase of a really good Boer goat will weigh up to 80 lbs. In this connection it is well to bear in mind the good milking capabilities of the Arabian or Indian goats, many of which are acclimatised and thrive on the coast.

Mr. H. E. Hornby: I have had experience of attempts to improve cattle in a part of Africa where there are no dipping tanks and ticks are numerous.. We found that our first cross got by imported European bulls was satisfactory, but when we crossed these half-breeds, even though not related among themselves, the second generation was disappointing; there being a great proportion of weedy animals which died or did not thrive. Also the susceptibility of these grade animals to tick-borne diseases and even more to skin disease made losses among them very heavy, so much so that in the end many people came to the conclusion that under the rough ranching conditions of that part it did not pay to attempt to grade up their cattle. While much might be done by selection of native stock I have found the greatest difficulty in being able to obtain the best specimens; natives are no mean judges, and I have not been able to purchase their best cows at any reasonable figure. Also, where oxen are used for trek purposes the total loss of the hump which follows crossing with a European bull renders the offspring less serviceable for use with the neck-yoke. A point of equal importance to the selection of sires is the castration of undesirable males, and certainly I think that Veterinary Officers and Stock Inspectors should use their influence to get castration much more widely practised on young animals than it is at present.

Captain R. H. Knowles, R.A.V.C. Mr. Doherty has impressed on us in his opening remarks that the grading of cattle must not be haphazard and the local conditions must be carefully considered in the method of the crossing which is going to be carried out. This applies especially to Sudan where very poor grazing exists. The Veterinary Department has done very little in the grading of cattle on account of lack of funds. The Veterinary Department runs a Dairy farm in Khartoum and in that way carried out small experiments in breeding. The chief aim in the improvement of the herd has been carried out by selection of native cattle. I may say that it is from a milk producing point of view that this dairy farm is run and improvements attempted. Our best results have been by the selection of the native cattle. Our highest milker at present is a cow of pure-bred Zebu stock.

The Chairman. In most of the native areas it appears clear that for several years to come the best results will be obtained by selecting and improving these native breeds in their own localities, because disease and ticks exist to which imported animals would rapidly succumb, often before they were able to leave their mark.

Mr. Hornby has referred to castration which I consider to be the first line of action to be introduced. It is Major Tissie who emphasises the objection to Madagascar beef owing to its dark colour consequent upon castration late in life. I would like an expression of opinion from this Conference as to the methods which they consider most applicable in native areas; whether it should be effected by the use of the knife or whether crushing of the cord might not be more simple and less dangerous for the native owner.

In addition to castration the inception of Shows at which sires and dams of approved types could be awarded prizes; the selection of certain of these sires for small premia or bonuses would I think quickly induce the native to follow the advice given him by the Veterinary Officers. In the discussion on trypanosomiasis it was made clear that the presence of people and of animals on the edge of the fly zones was beneficial in restricting the wandering of tsetse. Cattle are more valuable than sheep and goats, and it is worthy of consideration whether we do not think that large flocks of the smaller and less valuable animals might not also be better bush destroyers. Mr. McCall very rightly referred to the added value of the sheep which would grow wool or hair of marketable value.

From the reports of the last census taken in Basutoland we find that in 1921, the natives there obtained £63,750 for Angora hair and £212,000 for wool, derived from 894,000 goats and 1,800,000 sheep, a return of approximately 2/- per animal. In Eastern Africa the export figures show that only Shs.-/15 cents is obtained for each small animal and that is by its skin at death.

Mr. W. Kennedy: I agree with the remarks of previous speakers on the advisability of improving our native herds by a process of careful selection. Until our tick-borne diseases particularly East Coast Fever, have been controlled in our native areas I think it would be inadvisable to introduce either pure bred or grade bulls to these areas.

Many of our pastoral tribes exercise a considerable amount of care in the selection of stud bulls but their ideas with regard to conformation are rather different from European ideas. In the Northern Frontier district, I believe, the natives are guided to some extent in the selection of the male animals which they retain for breeding purposes on their ability to go without water for lengthy periods. Our natives readily appreciate the fact that heifer calves of good milking strains are likely to be good milkers but they do not appreciate that the bull is an important

factor in breeding for milk production. A question which is frequently asked is: "What is the best breed of animal to import into this country?" and I think Mr. Doherty has made it clear in his opening remarks that the conditions vary to such an extent in different parts of this country that it is quite impossible to lay down a hard and fast rule on this subject. With regard to the point raised by the Chairman in connection with castration, I may mention that some of our natives sterilise their bulls by crushing the testicles between two stones without breaking the skin, others use the knife. From the point of view of mortality, I personally do not think that the method adopted is of much importance provided the operation is carried out at a suitable season of the year, that is, when flies are not numerous.

Mr. F. J. McCall: With regard to the method of castrating adult cattle practised by natives in many districts of the three territories (hammering with stones) it seems to me that action might be taken by Government to discountenance and stop this cruel practice. In the towns natives are fined for beating oxen, or for using the nose rope, and the Society for the Prevention of Cruelty to animals attaches great importance to such prosecutions. I submit that the operation of castration by crushing between two stones produces much more pain and suffering than would be caused if the operation were properly performed.

In Tanganyika all Stock Inspectors and natives, subordinate staff, endeavour to influence the natives to discontinue this cruel practice and to castrate animals while still young in one or other of the recognised ways.

Mr. H. E. Hornby: With regard to the question of the suitability of straight backed grade animals for the neck-yoke, I have seen these used with success, but the tendency is for them to pull from the "neck-strop," and if the practice of encouraging animal transport among natives is to be followed the oxen best suited to their requirements are undoubtedly the humped ones.

Might I emphasise the importance, if grading is attempted, of using always pure bred sires, and of avoiding the use of so-called grade bulls. In Southern Rhodesia where the process of grading up is taking place faster than in any other part of Africa this practice *i.e.* the use of only pure bred sires, is emphasised. The point raised by Mr. Kennedy concerning the transmission of milk production through the sire has been settled long ago and it is known that if one parent be of more value than the other for transmitting those properties it is undoubtedly the male.

The use of pincers for the castration of bovines in skilled hands appears to yield eminently good results; or such was the impression I gathered when seeing the operation performed in South Africa by Dr. Veglia, who has done much to popularise their use in the Union.

Mr. A. G. Doherty: To my mind the important point is the selection of Sires suitable to the different types of country.

While emphasising a point of this nature, it must not be forgotten that there is country well watered and well pastured where the natives reside permanently without the necessity of trekking in search of pasture and water as the dry season advances. In country of this nature I think that imported blood can be used with benefit. The supply of country bred bulls of a variety of breeds and grades is plentiful, and I do think we ought not to lose sight of the advantage of using these bulls where the use of them is indicated.

Another point which was raised in the discussion, a most important point, is that the native of the cattle raising tribes does know a good animal. You are beginning, therefore, with natives who have their own ideas as to what contitutes a good animal for their purposes. It is very necessary therefore, that one should get in touch with the native mind on these points, and not regard their ideas as being ill-formed and ignorant, because in the native reserves you will find a lot of information amongst tribal elders that ought to be used in studying improvements that will be lasting.

The experience in the Sudan, with regard to imported blood, is very interesting. We see there that imported strains are quickly lowered to the level of the native, and below the level of the improved native cattle. Conditions in Kenya, however, are very different to those found in the Sudan.

The question of what imported breeds do best in East Africa has been raised. Our experience in the settled areas has been that there are districts and conditions to suit any breed. In the past the better-known British breeds, the Shorthorn, the Devon, Ayrshire and Hereford were most extensively used. Guernsey blood was imported to a limited extent. More recently Friesland were imported and this breed was represented by a strong class at the last Agricultural Show at Nakuru. It might be fair to say that, under natural conditions, the dairy farmer has obtained best results from the Ayrshire, and that the Devon has made the most use of our pastures under ranching conditions. For dairy purposes I consider that no other breed will repay food and labour like the Friesland.

As a matter of fact no breed has yet been proved under ranching conditions and, as in Rhodesia, we are feeling our way to discover not what is the most suitable to the whole country but what breeds do best under the varying conditions in various districts.

The question of castrating unsuitable males is a most important one in any attempt to raise the standard of native herds. The Burdezzi forceps have been discussed. I have had experience of these forceps in Ireland where I saw their use demonstrated by Mr. P. J. Howard of Ennis. It is claimed for them that they will effectively sever the cord in adult animals, and their use is strongly advocated in those animals subject to extensive haemorrhage. It is in adult animals that most work will have to be done in the initial stages of any scheme for improving our native cattle. Therefore I would recommend that Officers in native territories should obtain and demonstrate to the natives the use of these forceps on rams and adult bulls. The question has been raised with regard to grade trek oxen as against native trek oxen. Our experience in this Colony has been that grade oxen of certain breeds, the hardiest breeds, are good. A team of grade oxen was sold up country recently for £18 apiece.

Mr. J. WALKER: We have tried the Burdezzi pincers. They have been used in the castration of rams and also in the castration of pigs, young bulls and adult bulls. They have proved to be effective in the case of rams, but in the case of adult native oxen it is questionable whether they can be used as effectively owing to the thickness of the skin. I noticed that they were not very successfull where the skin of the scrotum had been thickened by tick bites. In calves and rams they were most effective.

Mr. A. G. DOHERTY: I should like to mention that there are two kinds of these pincers, short and long handled.

Mr. J. WALKER: The castrations I referred to were done with the short-handled pincers. We have not used the long-handled pincers so cannot say whether they are more effective than the short-handled.

(F) STOCK ECONOMICS.

(1) Animal Taxation.

Captain B. A. JARVIS, R.A.V.C. (Senior Veterinary Inspector, Sudan): I hope in a few words to put before you the system of herd or animal taxation in the Sudan.

The revenue derived therefrom, is fairly considerable and constitutes a great source of revenue for the country. The estimated amount to be derived for this year being £230,280. For the purpose of Taxation the Provinces are graded into 3 classes, according to the wealth of the Province, and the ability of the native to pay, also the nature of the work being done by the owner with his animals. It is natural, that in a large cattle rearing province, where great numbers of cattle and sheep are reared for export, those natives are in a better position to pay the tax than in a Province from which there is no animal trade.

The amount of the tax levied per head, from time to time, is adjusted according to the prevailing conditions, and the following table will give the rate of tax now in force. In working out the rate of exchange from Egyptian money into English money, fractions of a penny have been omitted.

	1st Class.	2nd Class.	3rd Class.
Camel, per head	5/0	4/0	3/0
Horse ,, ...	4/0	3/0	3/0
Cattle ,, ...	3/0	2/0	1/6
Mule or Donkey	7d.	7d.	7d.
Sheep	7d.	5d.	3d.
Goat	5d.	2½d.	1½d.

The tax is based on a ratio not to exceed 5 per cent. of the local market value of the animal so taxed.

Assessing the herds is a difficult and timely operation, and as far as I remember is done once every two years. The remittance of taxes through the inability of the tribe to pay as a result of adverse circumstances, such as loss of animals from disease, etc., rests with the discretion of the Governor of the Province concerned. All taxes so collected go to the Central Treasury.

To illustrate the variation in amount of taxes collected, I may say that one Province may collect only £130, whilst another province may collect £67,000.

For the benefit of those Delegates interested, I will quote certain paragraphs from the Ordinance in precis form.

1. Title. Taxation of Animals Ordinance.

2. Tax payable in respect of horses, camels, donkeys, cattle, sheep and goats, in such parts of the Sudan as shall from time to time be notified by the Governor General in the Sudan Gazette.

3. Tax payable annually.

4. Exemptions:—

(*a*) All animals belonging to a tribe which pays tribute or to a member of such tribe who is liable to contribute to such tribute.

(*b*) All immature animals.

(*c*) All oxen, ordinarily used for irrigation by sakias (water-wheels).

(*d*) All Government animals, and those belonging to officials who draw forage allowance.

The Chairman: This is a subject which I hope will be very freely ventilated at this Conference. We must keep in mind the possibility of stock taxation, although, naturally, we all earnestly hope it will not be necessary to impose such in Eastern Africa until the owners of stock realise fully the benefits that they have derived from Departmental operations. The imposition of a tax on Stock is very like putting a tax on capital, and such a tax has not been received in other countries with favour. In any case, I hope it may be possible for us to suggest for Eastern Africa that such a tax shall not be imposed, nor shall the owners be required to re-imburse the Government, until it is clearly brought home to them the benefits which they derive from our operations on their behalf. The imposition of a tax at the present juncture would act adversely on our activities, but in the future, owners may well be expected to reimburse the State.

Mr. J. A. Griffiths: There is no direct cattle tax in Nyasaland but suggestions have been made for a levy of 1/- per head on the native-owned cattle, in one of our districts, to provide and maintain dipping facilities with a view to eradicating enzootic East Coast Fever. The suggestion of the provision of dipping facilities has been recently brought forward by the natives themselves but so far no levy has been made.

Mr. W. Kennedy: My views on this subject, as far as Veterinary operations in native areas are concerned, are that until we have suppressed the epizooties which are at present decimating our native-owned herds, it is not advisable to call upon the natives to pay for Veterinary Services. I agree that when the natives have had time to realise the benefits they have received from Veterinary activities they should then be called upon to defray the expenses which were incurred by the Government on their behalf.

Captain B. A. Jarvis, R.A.V.C.: I have practically nothing more to say about taxation. I think it is a question for the different countries to decide for themselves.

(F) STOCK ECONOMICS.

(2) Milk, Milk Products and Ghee Production.

Mr. E. Hutchins (Chief Veterinary Officer, Uganda): In Uganda the only milk product of importance is that of native butter, the production of butter by non-natives has not yet been undertaken, except by a few planters, and then only on a very limited scale. Native butter is, in some districts converted into Ghee of inferior quality. I have only recently returned from leave, but during my absence steps have been taken to develop the production of Ghee in Uganda where it is the only form of milk product suitable for the native to engage in at present The Chairman has had much to do with this subject in Uganda. He has given considerable attention to it during the last year or more.

As regards Ghee as a native industry. In some districts there is a surplus of milk, especially amongst the pastoral tribes, but except for small quantities of bad butter which is converted into bad Ghee, very little of this surplus is used.

Pastoral people as a class usually, have not much ready cash to pay taxes, and although their requirements are now limited, they are bound to increase as time goes on. Native cattle at present have not a high average milk yield, but the milk has a high butter fat content. Better management would give bigger yields in milk, and this should extend over longer periods. Therefore the development of markets for milk and milk products will stimulate trade, and bring about increased circulation of money, which will encourage better management of milk cows and by degrees better breeding and increased production.

Arising from this, more valuable products than Ghee may eventually become marketable. The main ambition of the Uganda Government as regards this is to demonstrate that cattle can and will produce more money, to provide the justification for their maintenance, and gradually their improvement. I would ask the Chairman to speak on this. He has done a great deal on the question during the past 18 months or so.

The Chairman: In the absence of a market for meat, the surplus milk of the cattle in these territories provides a good substitute. Ghee is in demand pretty well throughout the world, and especially in Africa and the East. British India in the last three years has exported Ghee to the value of over £400,000 a year, whilst non-British India, Native States, etc., has in all likelihood exceeded that figure. The East African group of Territories have, in spite of their large number of cattle imported during the past ten years Ghee to the value of over £23,000 a year, in one year exceeding £56,000. In one year only within this period did they export more than they imported, and that was owing to the production by Tanganyika Territory of Ghee to the value of £66,000 The difference in favour of the export in that year was £9,500.

I will give you a few figures to indicate the consumption of Ghee in some of the Eastern countries: The Straits Settlement for the past three years imported over £100,000 worth annually, Ceylon over £30,000 annually, Mauritius £26,000 worth annually. The united Kingdom has taken about £5,000 worth annually. Even the Union of South Africa imported in 1921 Ghee to the value of £55,000 at a price of £7.10.0 per cwt.

A glance at the value of Ghee dealt with in Eastern Africa shows that it varies in value from Sh. 20 cents to Shs.1/80 per pound. The essence of Ghee production therefore, is to get the best quality; we realise that in the past, partly on account of quality, and partly of sentiment, Ghee has been imported from India, where the average value last year was Shs. 1/32 per pound. Further, that Indian Ghee was consumed mostly in towns and at the coast, the up-country stations and the small Bazaars being supplied with Ghee of local production, which in many cases is rancid and nauseating.

Why Indian Ghee should be better than African Ghee apart from sentiment, is that they have by custom, adopted better methods of preparation. In African territories, production has generally been left to the individual, and before that individual has got a sufficient amount to fill his tin, the earlier lot has become rancid, thereby contaminating the whole.

The policy in Uganda is to encourage the native to bring fresh butter, even in small quantities, to a buying post, where he is paid a fixed rate per pound. The butter being always fresh, a fresh and uniform sample of pure Ghee can be prepared, and the reports so far, are excellent. That policy encourages the daily turnover of money. The posts are placed in convenient situations, according to the density of cattle, and the native realises it is better to keep a good milking cow, to keep more cows, and improve them, as his cows give him money, and not milk alone. The average milk of the native cattle in East Africa is very rich in cream, consequently a smaller volume of milk will produce a greater volume of butter than is customary in Europe. On the assumption that each cow can provide a surplus of a quarter of a bottle of milk a day, and that 39% of the cattle are female, a total quantity of 137,000 cwts. of Ghee can be produced annually in Eastern Africa. The value of this will depend upon the quality, and upon the market. With regard to the market ability to absorb it, naturally we have little evidence, but the figures I have given to show the export trade from India, and the price at which that Ghee is sold there indicate to me that East Africa may well become a competitor. The demand for Ghee among Asiatics and Africans at least, is steadily increasing, and every native no doubt looks to the time when he can get more fat, a dietary which will unquestionably be to his benefit. As Mr. Hutchins has indicated there is no reason why, irrespective of colour or race of the supplier, these buying posts for butter should not definitely become centres, similar to the District Creameries of Europe, where products of a higher value than Ghee and where by-products should not eventually be prepared.

Mr. F. J. McCall: In coming to the subject of Ghee, I think we have arrived at what is possibly one of the most important economic products which it is our duty to foster. Recently when going through some of the largest cattle areas of Tanganyika I enquired into the price of local Ghee. This, I was informed, worked out at from Rs. 4/50 to Rs. 7/- per 36 lbs. At the same time, a notice appeared in one of the local papers to the effect that Ghee, prepared from separated cream, had been sold in Dar-es-Salaam for Shs. 63/- per frasila of 36 lbs. I think these two prices give food for reflection.

I was most interested to hear from our Chairman, of what is actually being done in Uganda, and I will make representations to my Government, with a view to inaugurating a similar system in Tanganyika. We have already procured the assistance of a Dairy expert and hope to make progress during the ensuing year.

Captain B. A. Jarvis, R.A.V.C.: The average annual export for the years 1913-20 from the Sudan of butter and ghee was 125 tons representing a value of £16,830.

Mr. F. J. McCall: Whilst discussing this subject it may be of interest to students of matters in Arabia to refer to the most excellent work on that country by Charles Doughty. Dealing with the subject of Ghee he points out that Samn, viz., Samli or Ghee, forms the currency of the Bedouin in the interior. His description of the caravans which convey clarified butter to Jedda is highly instructive and illustrates the importance of this commodity.

Ghee is undoubtedly an asset of the greatest economic value in Tanganyika, and one the production of which is well worth fostering. In 1920 and 1921, 27,660 cwts. of Ghee, valued at £98,541, Shs. 16, was exported to India and Zanzibar.' The peculiar advantage of Ghee over other produce is its relatively high value in comparison to weight and bulk, as on this account it can be transported from outlying districts, to an extent which is impossible in the case of grain, ground nuts, etc.

Captain R. H. Knowles, R.A.V.C: Why should there be such a great crossing of exports and imports?

The Chairman: It appears to be solely a question of quality. The Indian traders buy up a certain amount. What is unfit for consumption in this country, they export in bulk to India where a considerable amount is purified for sale as Ghee and possibly also as tinned butter.

TERRITORIAL IMPORT AND EXPORT GHEE TRADE.

	IMPORT.										EXPORT.										DIFFERENCE.	
	KENYA.		UGANDA.		TANGANYIKA.		ZANZIBAR.		TOTAL.		KENYA.		UGANDA.		TANGANYIKA.		ZANZIBAR.		TOTAL.		IMPORT.	EXPORT.
	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	Cwts	£	Cwts.	£	Cwts.	£	Cwts.	£	£	£
1911-12	2596	7,269	—	—	—	—	—	28,032	—	35,295	3167	9,355	2911	5,819	—	—	—	7,048	—	22,222	13,073	—
1912-13	2359	7,207	—	—	—	—	—	31,515	—	38,722	3572	10,638	4737	11,439	—	—	—	8,109	—	30,486	8,236	—
1913-14	5456	16,296	—	—	—	—	—	26,363	—	42,659	1162	5,063	4851	12,507	—	—	—	4,306	—	21,876	20,783	—
1914-15	6309	19,243	—	—	—	—	—	22,491	—	41,734	704	3,137	4693	12,264	—	—	—	3,434	—	18 835	22,899	—
1915-16	5080	15,690	—	—	—	—	—	32,508	—	48,198	1534	6,901	4591	11,999	—	—	—	6,928	—	25,828	22,370	—
1916-17	5837	19,692	—	—	—	—	—	36,358	—	56,050	1113	5,746	7007	18,310	—	—	—	9,590	—	33,646	22,404	—
											Cwts.		£									
1917-18	6727	28,620	—	—	—	—	—	30,309	—	58,929	653	—	3376	—	—	—	—	4,346	—	7,722	51,207	—
1918-19	6407	25,580	—	—	—	—	—	48,330	—	73,910	201	—	961	—	—	—	—	16,485	—	17,446	56,464	—
1919-20	5429	22,907	—	—	—	453	6849	56,269	—	85,025	2036	—	11090	—	15059	66,748	—	16,651	—	94,489	—	9,464
1920-21	8137	40,986	—	—	—	1,400	5386	30,443	—	76,815	1097	—	9164	—	12600	31,792	—	9.156	—	90,112	26,703	—

(F) STOCK ECONOMICS.

4. Meat and Meat Products.

5. Hides and Skins.

MEAT INDUSTRY IN MADAGASCAR.

Veterinaire Major PAUL TISSIE (Chef du Laboratoire Veterinaire, Antananarive, Madagascar): We have in Madagascar:—

1. One freezing factory at Boanamary, near Majunga. This was erected in 1912. Three to four hundred oxen can be slaughtered there daily, and the freezing stores can hold 3,000 tons of frozen meat. This amount was produced during the year 1922. In 1923 a production of 3,200 tons is expected, over and above 300 tons of preserved meat for the Army. The beasts used in this factory are derived from:— (*a*) The province of Majunga, in which there are 744,405 bovines; (*b*) the province of Maevachanana, 759,635 bovines; (*c*) the province of Moramanga, 373,669 bovines. The animals from the above province travel overland. (*d*) The province of Morondava, 939,744 bovines; (*e*) The province of Tulear, 665,195 bovines. The animals from the two latter provinces travel by sea.

2. One freezing factory at Tamatave erected in 1913. The Refrigerating Chambers there have the following dimensions 47 × 26 × 8.40 metres. One cubic metre allows space for 350 kilos of dressed meat. In 1922 this factory produced 1,280 tons 796 kilogrammes (equals 6,400 oxen) of frozen beef and 206 tons of. frozen pork. One hundred animals can be handled here daily. Animals are obtained from the Province of Tananarive—336,328 head of cattle, and from Moramanga—373,659 head of cattle.

3. There is a factory for preserved meat at Antsirave, which in 1923 manufactured canned meat for the civil population. This factory can cope with 15,000 tins daily. Animals are derived from the province of Antsirave—containing 223,474 head of cattle.

4. One canning factory at Antongobato, near Diego, erected in 1906. 150 animals can be handled there daily. Source of the animals from the provinces of Diego, Vohemar and Amdilote containing 572,755 head of cattle.

5. One canning factory called "Seama", near Diego, built in 1912, can handle 120 head per day. The animals are drawn from Analalava—280,974 head of cattle, and Diego, Vohemar and Amdilote containing 572,755 head of cattle.

6. A canning factory at Tananarive, erected in 1915, can handle 100 animals daily. Source of supply Antananarive—336,328 head of cattle.

7. A canning factory at Ambohimasoa, which chiefly handles pigs (canned pork, hams, salt meats, and lard). A few poultry are also handled there.

8. A small canning factory at Tsaxahonenana, near Antananarive. This factory handles a few pigs and poultry (canned pork, hams, salt meats, and lard).

9. There are about 30 lard factories in the province of Tananarive, 10 in the province of Ansirabe, 5 in Tenarantoa, and 2 in the province of Meraseranga.

10. It is proposed to erect another canning factory at the south of Tulear, near the Bay of St Augustin. Animals used there will be derived from the province of Tulear—665,195 head of cattle.

Beef.—The oxen from the east and central portions of the Island exist on a soil with a granite sub-surface. The animals here are not so good as those from the Western provinces, where the subsoil is chalky.

In Madagascar: (1) In the centre the soil is absolutely clayey and is not very fertile. (2) There is an intermediary region, between the coast and the centre of the island. There the soil is alluvial, having been carried down by rains from the high central altitudes. This soil is fertile, the climate is warm and moist. (3) The eastern sea coast. On this coast the soil is full of silicate, and sometimes calcareous through the presence of coral. (4) There is a calcareous zone in the west. In the parts nearest the central hills the alluvial soil washed down by the rains is mixed with lime, the soil being of a clayey calcareous nature. This is very fertile, and it is here that the finest herds of the island exist. (5) In the south-west the sub-soil is chalky, and is often mixed with sand which exists on the surface. There the soil is fertile, but the rainfall is small.

The total number of bovines in the Island is 8,000,000 head. The native animals are of the zebu type, with a hump, and are called by Zoologists "Bos indicus." The zebu was probably primarily imported from Africa, the Arabs colonised the Comoro Islands during the ninth century, and introduced the zebu there. From the Comoros those Arabs went to Madagascar with their herds.

Census.—A yearly census is carried out regularly, the same system being applied each year, one can therefore surmise that the difference between two consecutive years added on to the yearly local consumpton, would shew the increase in the herds. Thus, 1921 census = 7,518,657. Census 1922 = 7,829,183. The difference between these figures = 310,526. Annual consumption = 300,000. Total increase = 610,526.

The Zebu as a slaughter animal: There is a special type of beast for slaughter purposes. The animals having very light bone and consequently carrying more flesh. These oxen when very fat weight over 400 kilos (*live weight*) and give from 55 to 58 per cent. meat. Pit oxen, *i.e.* (those fattened in pits) go up to 520 kilos. giving 60 to 62 per cent meat.

The failings of the zebu for meat production are:— (1) The meat is too red, through late castration, and the semi-wild conditions of existence. (2) The meat is not interspersed with fat, the fat being present only on the surface and around the kidneys. (3) First category meat is not very abundant as the quarter is short and not well furnished. (4) The length of the body is small as compared with the height of the chest (74 centimetres) the length of the animal from the base of the hump to the base of the tail averaging 1.05 metres. (5) The animals do not mature early, as they do not grow well during the dry season. A beast is not full grown until he is seven years old. The average weight of an ox from the western parts of the island is 350 kilos, whilst in the east, 300 kilos is the average.

Fattening.—(1) Grazing at large is only practicable from January to June. (2) The second process is in pits on the high plateaus, oxen are placed in separate pits of from 10 to 16 metres in diameter. The animals are only taken out of these holes to go to the slaughter house, and the fattening process lasts on an average eight months. As a ration, the animal gets grass *ad lib.*, especially the type of grass called *Panicum colonum*, *Leersia hecandra*, *Nympha stillata* and rations are completed with manioc, rice refuse, and stems of bananas.

Quality.—Mr. Mithiaux of Paris, an expert in meat, has classified the meat of Madagascar animals exported alive to France, as follows:— First category, fillets, loins and hump—tender and succulent meat. Second category, for roast and steaks. Second grade meat is slightly tough, but palatable. If suitably cooked it is perfect. Third category. This is very good for soups, broths, potage etc.

Exportation of live animals:—Live beasts are exported to Reunion and Mauritius. In 1922, 13,400 head were thus exported. The price of beef in 1922 was centimes 40 per kilo live weight for good grass-fed animals, and 55 centimes per kilo for "Pit" animals. It might be thought that the exportation of live Madagascar oxen to Europe would pay, as oxen now at the Vilette market are worth from 3.20 francs to 5.40 francs per kilo. But in fact, with cost of transport, mortality, and loss of condition of the animals during the journey etc., profits would be very small.

Export of frozen meat.—This process avoids losses through deaths and loss of condition, freights are thereby diminished, and all other expenses attached to the exportation of live animals are done away with. Madagascar has a large number of animals that could be exported yearly, (about 300,000) but only from January to the end of July, except pit oxen, which are always available. According to one of the Directors of the Societe Rochefortaise, the export of frozen meat can only pay if the value of oxen does not rise to more than 50 centimes per kilo live weight. At the Boanamary Freezing factory frozen quarters weigh from 45 to 48 kilos. In Tamatave (pit oxen) the quarters weigh from 50 to 58 kilos. Loss of weight in freezing in 48 hours 3.04%; in 72 hours 4.67%; in 94 hours 4.94%.

Exportation of Canned Meats.—The canning factories in Madagascar make up meat as follows: Boiled beef, corned beef, and preserves from the tongues, tripe and brains. The natives, for their own consumption, make what could be called "Biltong," *i.e.*, salted strips of flesh dried in the sun.

The following is the result of the manufacture of 2,000 tons of preserves at the Boanamary factory in 1918 (Military supplies) Number of oxen slaughtered, 44,630: Total weight of meat slaughtered, 6,554,605 kilos or 164.83 (per head); Useless for preserving (neck, legs etc). 538,821 kilos or 8.22%; for actual treatment 6,015,784 kilos or 91.78%; first dressing weight of fat tendons etc., 1,388,897 kilos or 21.18%; weight of meat after cooking 4,626,887 kilos or 70.58%; second dressing tendons etc. 782,895 kilos or 12.29%. Tins made 2,000,000 kilos. Preserve obtained per head 44.38 kilos.

Exportations of canned meats, frozen and corned beef in 1921 amounted to the sum of 12,359,245 francs. In 1922 from January to November, canned beef was exported to the extent of 177,128 kilos, and export of frozen meats amounted to 4,278,876 kilos.

Bye-products.—Twenty-two oxen weighing 23,694 lbs. or 1,077 lbs per head gave the following:—Meat 60.08%; Skins 7.40%; Fat 5.80%; Dried Blood 8 lbs per head. The fat gave 80% of suet (first quality) and this suet gave 59.77% of olein and 19.52% of stearine.

Hides.—In 1922, the exportation of ox hides from January to November, were Salted Hides, dry, 2,160,198 kilos. Salted Hides, green, 1,187,941 kilos. Hides treated with arsenic 2,354,428 kilos. Average weight of green hides, 25 kilos. and dried hides 13.75 kilos.

Pigs.—Pigs were imported in the 16th Century by the Portuguese. The breeding of pigs in the Colony is a paying proposition for the following reasons:— (1) Contagious diseases which exist in Europe and America are unknown. (2) Food (potatoes, manioc, sweet potatoes, etc.) can be produced in large quantities at low cost. (3) Extremes of temperature are not very great. It is easy to protect these animals against cold or heat. (4) Labour is cheap as compared with other

producing countries. The breeding of pigs can be undertaken by smal. owners, for a small number of sows are sufficient for the foundation of good herd fairly quickly Returns from the pigs are quickly obtained, and this allows breeders to wait for revenues from other undertakings. The sow is very prolific, and given two litters a year assures an immediate income.

During the war, the high prices obtained for lard induced breeders to slaughter pigs of all sizes, therefore, to avoid their rapid decrease an order was passed prohibiting the slaughter of pigs under 80 kilos live weight. Native pigs weigh about 75 kilos at one year old, and there are 550,000 head in Madagascar. Native pigs have been crossed with Yorkshire breeds when lard was expensive, and subsequently with the Craoumais breeds which give more meat. At present one finds different types of pigs from the small native pig, weighing 60 to 80 kilos, to the type Yorkshire, Craoumais, weighing over 300 kilos.

Markets have been flooded with cheap lard from America. It is therefore, better to breed flesh producing pigs as pork is still dear in France. For canning or preserving, the flesh must be firm, palatable, and not too fat, so that it does not melt in the autoclave. In Paris the type of pigs for which the best sale is found, is the small pig from Vendee well furnished, and weighing from 60 to 70 kilos. Canada understanding this, has bred up a type of Wiltshire of about 75 kilos.

Products from Pigs.—Nineteen pigs weighing 2,854 kilos, an average of 145 kilos, gave the following:—Fat, 965 kilos; boned meat 768 kilos; bones 186 kilos, hides 131 kilos; tendons 16 kilos; boned heads 70 kilos; and feet 40 kilos.

Other returns:—

	Fat.	Boned meat.	Total percentage of meat.
Native Pig, very fat ...	99 kilos	45 kilos	45.5%
.. .. in fair condition	89 ..	42.5 ..	47.8%
.. .. thin	56 ..	29 ..	51.8%
The three mixed	244 ..	116.5 ..	47.7%
Yorkshire, very fat	189 ..	82 ..	44.3%
.. fat	116 ..	53 ..	45.7%
All five together	545 ..	251 ..	46.1%

Products from 6 pigs, live weight 938 kilos, dead weight 806 kilos, products equal 86.30%. Fat and residue 54% of the dead weight, flesh 45.7%, lard extracted from fat 69%. One native pig, very fat, gave 64% of fat (in comparison to the total amount of flesh obtained from the carcase). One native pig, fat, gave 60% of fat, and a fat cross bred pig gave 66.88%.

Boned Meat for salting (after the limbs have been cut above the knee and hock and the intestinal fat has been stripped). Twenty five pigs, live weight, 1,875 kilos, gave 1,275 kilos of boned meat, that is 51 kilos per head equals 68%. Thirty one pigs, live weight 3,162 kilos gave 1,643 boned meat 52%. Weight of bones, small varieties 5%., large varieties 7%., for all animals over 150 kilos, 8% (heads not included) and all being fat.

Fat Products.—Export of lard in 1922, 127,605 kilos. From January to June the fat is too watery. It only gives 3/5ths of its weight in lard. From June to December the average is 2/3rds. The internal fat, provided it is not mixed, can give as much as 80% of lard.

Salt Pork is also exported to Reunion and Mauritius—16,617 kilos having been sent between January and November 1922.

In 1917, the exportation of live pigs was tried, the results were not good and this has, therefore, been given up

The Societe Rochefortaise at Tamatave exports frozen carcases.

Sheep.—The native sheep have very tough flesh, and this is pratically useless. Grading has not been carried out on a large scale.

Poultry.—The fowls in Madagascar are big, but they are light and not very fleshly. They are not unlike the Baukhiva breed. Ordinary chickens were worth Fr. 1.40 in 1922 and capons from 8 to 10 francs. Breeding by selection does not exist, each individual keeping a few birds for household purposes. There are several crosses existing with the Houdan, Crevecoeurs, Leghorns and Faveroles.

Geese do well in the marshy districts. The type of geese is a special one having a protuberance on top of the beak. The Associate Saupiquet has tried to obtain fatty livers from geese for the production of Pate de Foie gras. It succeded in producing a certain amount of fattiness with a large capsule of fat round the organ but there was no hypertrophy of the liver. To obtain suitable livers one would need to cross the Madagascar goose with those derived from Toulouse.

Ducks are very numerous in Madagascar. The types are similar to what is called the Rouen duck, and the duck from Barbary. A cross between these gives a hybrid, which is sterile. This hybrid is bigger than the Rouen duck, and the flesh is better than that of the Barbary duck. These hybrids produce hypertrophied livers when treated at Antsirave in Saupiquet's factory. After purchase the ducks are kept 15 days, plenty of food being given. They are then forcibly fed or stuffed for 25 days with half cooked maize, the quantity of the ration varies greatly,

averaging about 280 grammes, but in the middle of the period of forced feeding they can absorb up to 400 grms. daily. This cannot be done at the beginning and the end of the process. The liver at the time of slaughter weighs about 450 grammes, and some may be as much as 700 grammes in weight. The hybrid gains during forcible feeding over 2 kilos. The cost of production and feeding is small. There is a plentiful supply of maize on the Societe's property, and a woman paid at the rate of 70 centimes per day, can feed 80 ducks.

Wool.—There have been few importations of wooled sheep in Madagascar. In 1921, all grade sheep in the country were collected and sent to Ambovoma, a place near Fort Dauphin. The weight of the wool collected per head varied between 1 kilo 200 grammes, and 3 kilos 450 grammes. The Chamber of Commerce at Tourcoing wishes to start breeding wooled sheep in the South of Madagascar, where the soil is sandy and the sub-soil calcareous, but first they will have to destroy the plant called Andropogon contortus, by ploughing and planting artificial grasses. The Andropogon contortus causes wounds of the eyes and first portion of the digestive tract.

THE CHAIRMAN.—I am sure we are all of the opinion that Major Tissie has given us an instructive and valuable address on the animal industry in Madagascar and our congratulations should go to his Government for their enterprise and foresight in being able, in the space of some 11 or 12 years to establish this very valuable industry. It is of particular interest to us in Eastern Africa where we possess large herds of cattle for which profitable markets ought to be found and developed. It is the ultimate ambition of the Veterinary Authorities in this country that their activities will conserve the existing stock, and improve it so that it may be suitable to and profitable for the markets. We welcome considerable discussion on this subject from all the Delegates present, and it is regrettable that Major Tissie himself has to leave us this morning, together with the South African Delegates. I would ask you, therefore, to confine your observations at this moment to questions which you would like Major Tissie to answer, allowing, however, the South African and Portuguese East African Delegates the opportunity of their full addresses.

My own questions to Major Tissie are:—Would he inform us of the type of meat mainly used for the production of meat extract; what percentage of extract is obtained from the meat so used, and for what purpose this extract is used in Europe.

Major P. TISSIE: When canning meat for the Military, the factories have to put the gravy or bouillon in the tins with the meat (200 grammes of bouillon and 800 grammes of meat), but when preparing supplies for the Civilian population the bouillon is evaporated and used for making extract. The percentage can be worked out from the following figures 44,893 oxen treated for canning purposes yielded 35,000 kilos of extract.

THE CHAIRMAIN: I take it that meat, as meat, is not compressed into extract in Madagascar?

Major P. TISSIE: Animals as a general rule are not slaughtered exclusively for the production of extract, but this year the price of beef in Madagascar was as low as 18 centimes per kilo so that one of the factories thought it would be a paying proposition to purchase animals for the sole purpose of producing extract of beef.

THE CHAIRMAN: Has that proved profitable?

Major P. TISSIE: I think that this may have been profitable, but cannot state definitely as it was only started this year. 5,000 cattle have been used for this purpose since the beginning of this year: the extract is exported to France for general use as such.

Mr. F. J. MCCALL: (1) Are factories subsidised by Government? (2) are the shipping companies subsidised by Government, and to what extent? (3) Is any difficulty experienced in inducing the natives to abstain from slaughtering immature cattle, and has any legislation been enacted in connection with this? (4) With regard to pigs—are the natives Mohammedans? (5) are there any factories in the interior where cattle are killed, and if so, is frozen meat brought from the interior in chilled compartments, to the Coast?

Major P. TISSIE: (1) There is no subsidy given by Government, but the Government tries to help the producers of canned meat by giving them a contract to supply the Military: this year the contract was for about 300 tons canned produce for Military consumption. (2) Some of the factories have their own boats and the Shipping Companies are not subsidised by Government, but to allow the Societe Rochefortaise to be repaid for its expenses on fitting up ships of the Compagnie Haveraise Peninsulaire for the purpose of transporting frozen meat, the Government guaranteed the purchase for military purposes of all frozen meat produced up to the year 1925. (3) There is no difficulty due to the slaughtering of immature cattle by natives, and up to now this is of no importance because the number of animals available yearly is greater than the number used for consumption. During the war, however, when the consumption was very high the factories were induced not to kill animals under 200 kilos live weight. (4) *Re* pigs and Mohammedans: There are not many Mohammedans, the only exception being a few at one of the ports. (5) There are no factories in the interior. All the factories are on the coast.

Captain B. A. Jarvis, R.A.V.C. There is no doubt from the paper that Major Tissie has had read to us that the meat industry is of the greatest importance to the Veterinarian. In the Sudan the chilled meat question has been brought up, but up to the present we are only dealing with the export of livestock, skins, etc.

I should like to ask Major Tissie to what other markets besides France does the frozen meat go: is there any frozen meat sent to Egypt?

Does Major Tissie think the quality of meat produced in Madagascar will ever be able to compete with the quality of meat produced in America. That is, are they expecting to grade up the cattle in such a way as to cut out the American trade? I understand the quality of the meat from Madagascar is very poor compared with that of America.

Major P. Tissie: They have no other markets at present besides France. There is no meat exported to Egypt from Madagascar. The present quality of Madagascar meat is certainly not equal to the American, but generally speaking the pit fed oxen would certainly compete very well with the meat imported from America. No steps have been taken for grading up the cattle. The importation of pure-bred or high grade bulls for breeding purposes is not carried out on a large scale. Only about ten bulls have been imported up to now, and the progeny of these animals are used mainly for transport work.

Mr. W. Kennedy: Could Major Tissie inform us what percentage of the total cattle in Madagascar is available for export? He supplied figures which show the number of animals killed at 300,000 *i.e.* 4%. Is the whole of this 4% available for export or are some of these animals consumed in the country?

Major P. Tissie: The number of animals available yearly for consumption is approximately 610,000. 300,000 of these are consumed locally and the balance, approximately 310,000, are available for export. The slaughter of cows is forbidden by law except in cases where they are barren or when they are over 10 years old.

With reference to tuberculosis. At the slaughterhouse in Tananarive in October 1921 rejections represented 0.63%; in November 1921, 1.05%; in December 1921, 0.85%; and in January 1922, 0.17%.

Tuberculosis in pigs is usually confined to the head, and rejections are few, because even when present only the head need be thrown away.

Mr. H. E. Hornby: Is castration generally practised, or are the exported animals all bulls?

Major P. Tissie: All oxen either for export or local consumption are castrated. Unfortunately, the operation is not carried out until the beast is three years old, the meat therefore is not unlike bull's meat. The natives argue that if cattle are castrated earlier in life development is stopped.

Captain B. A. Jarvis, R.A.V.C. I have figures of the Sudan trade before me from 1907 to 1920. In 1907 the total export value of cattle, sheep, goats, untanned hides and skins was £31,680, and in 1918, which was our greatest year, it was £1,378,556. At the present time the export trade in livestock and the supply of meat is practically entirely for Egypt. The whole of our export trade depends on the market in Egypt. At the present time there is depression there, which has affected the cotton market, and reflected back on the meat industry.

Mr. W. Kennedy: So far as this country is concerned there is no export meat trade worth speaking of. I have no figures by me as to the export of hides and skins, but our Chairman has recently gone into that question, as it affects Eastern Africa.

The Chairman.—Before speaking on East Africa I have here a copy of the last Despatch received from the British Consul in Madagascar giving the items and total of the trade there in the last two or three years.

In spite of the depletion of this Conference I feel that this subject introduced by Major Tissie is of such importance to us that we must ventilate our opinions as much as possible.

Eastern Africa, meaning Tanganyika Territory, Kenya Colony and Uganda, possess amongst them an estimated number of 7,000,000 cattle. It is probable that is an under estimate, and that 8,000,000 or 9,000,000 may be the correct number. I took out recently the details of distribution of stock within a zone of 200 miles on each side of the Uganda Railway, the branch line to Moshi and the Lake service on Lake Victoria communicating with the Uganda Railway. Within that zone there are approximately 6,000,000 cattle ranging in density from less than ten to the square mile to more than 40.

These cattle at the present time are small, fine boned and for the most of the year in good condition. The great majority of them are native-owned, and they are capable of great and rapid improvement by selection and by crossing with better stock.

In the centre of this zone referred to are the Highlands in which we are now. In these Highlands are a considerable number of imported and grade animals eminently suitable for crossing with the native stock. At the moment that cannot be done to any extent on account of disease in the native areas, but with the suppression of disease I can foresee a ready sale for the animals bred in the Highlands.

This rough native animal, capable as we deem it of improvement with breeding, is in the present condition of the Reserves, badly attended to and badly fed. Exceptions to that, needless to say, occur. But such rough animals when put under good conditions and management rapidly improve in condition and quality, and again, it appears to me that at no distant date it will be practical politics for the occupiers of the Highlands to function as graziers for the roughly grown native animal.

The inception of a trade in meat would be most desirable at the present time, although stock by themselves possess a very real value to the native owners, and by proper exploitation of their hides and ghee it is possible to develop a trade of some magnitude.

Most ranching countries accept about eight to ten per cent as their surplus. In Southern Rhodesia 8% was taken as the annual surplus of mature stock, and of that between 3 and 4% was deducted for local consumption. If we take 4% as the figure in East Africa we arrive at a total of roughly 275,000 available annually.

One of the greatest obstacles to the establishment of such an industry is the present lack of desire on the part of the owners to dispose of their stock. I am convinced that this is in a great measure due to the fact that they have not got a surplus. Their desire to possess herds and so rival their neighbours is a natural one, but as with the development of idle lands and other encouragement of the native peoples, this may be righted, and I think it may be accepted as a duty of Government to encourage the native to exploit his stock properly.

We know that, at the present time, the world's meat market is in a very poor way. This is largely due to the inability of the Central European Powers to purchase meat owing to the very abnormal rate of exchange. It is partly due also to the accumulation of frozen and tinned meats during the war, and it is undoubtedly due in some measure to the controlling interests of Trusts and Combines. I, personally, doubt very much whether there is enough meat in the world at the present time to go round if everybody were able to buy what he wanted and what was necessary for his consumption, and consequently the present position is abnormal and will change. Cheapness of cost of production is an essential factor, and it would appear clear that the high cost of land, of cattle and of labour in America and Australia will tend to augment rather than to lower the present price of meat in London when things become more normal.

I can conceive of no country being better able to produce cheap meat than one which is primarily native. He has no rates, small taxes, and no expenses of maintenance or feeding of his animals, and actually it costs him no more to keep an ox till five years old than it does for him to keep a goat for the same period. The natives of East Africa, and of Kenya in particular, have become of recent years accustomed to fictitious prices caused by the influx of European Colonists, and by the war, but if he can be assured of receiving Shs. 50/ for a five or six years old animal, averaging in dead weight about 250 lbs he would be well remunerated for his expenditure, and interest on his capital. This sum allows him about ten cents per lb live weight. A trade on the basis of the figures I have given will represent £687,500 per annum to those territories, and once initiated no one can doubt that the numbers and the quality will improve. The hide and skin trade has also been touched upon by Major Tissie. During the nine years of 1913-1921, Kenya and Uganda exported hides to the value of £165,872 per annum. The Tanganyika figures for the same period are naturally not available owing to war dislocation, but I take an average of £130,000 a year as representing their export. Converting these figures into hundredweights on the average prices ruling and taking ten hides to the cwt., we reach an export of 667,000 hides. Even that figure represents only about 10% of the total cattle population, and I feel sure we are all agreed that the average mortality in the cattle throughout these periods was greater. If we can get half as many again, and if by a process of education we can induce the owners to improve the value by only 25% we reach a possible figures of £554,000, a direct gain of £250,000. I, personally, believe that by organisation, initiation and propaganda we can hope to achieve an appreciable amount of this within a very short time.

Mr. H. E. Hornby: Ten years ago when there was regular trade in cattle from North to South Rhodesia it was estimated that the cost of rearing an adult ox by a European farmer in North Rhodesia was less than £1, and that the cost of driving them on foot over the 500 miles to Salisbury was less than £1, so that if the farmer could get not less than Shs. 40/- he was well paid for his outlay.

Mr. F. J. McCall: I have just had the opportunity of perusing Major Montgomery's interesting diagrammatic map, indicating the numbers of cattle within a 200 mile zone to the Uganda Railway, and the Lake. Whilst recognising its great instructive value from a diagrammatic point of view, nevertheless we of Tanganyika can seriously attach no relative significance to any scheme that includes cattle actually on our own territorial railway as being of importance to the

railway sphere of the adjoining Colony. This possibly is not the broadest view to take of the situation, but nevertheless we must remember that in Tanganyika we possess herds of cattle greater than those of the other Colonies adjoining, and in fact the ratio between Tanganyika and the other adjoining territories combined is as five is to six.

With regard to the feeding of native cattle by Europeans with a view to improving the quality of the carcase, Major Tissie of Madagascar, has recently raised a most interesting point, namely, the feeding of these animals in pits by the natives themselves. Personally, I am of the opinon that on the whole the native cattle in Tanganyika during the rainy season exhibit a spectacle of most convincing health and fatness. It stands to reason that if an attempt in Tanganyika is to be made to market meat the fundamental basis of such an attempt must be the utilisation of these animals during the rainy season when naturally pasture is good, and the cattle are fat. By doing so we obviate the necessity of attempting to fatten animals during the dry season. If during the dry season the price of meat for canning, freezing, or export purposes was decidedly greater we might be justified in going to the expense of artificial feeding, but as I understand the price does not vary seasonally to any great extent, then the object of fattening animals by hand is scarcely clear. In Tanganyika we have already accepted the general principle that the Veterinary Department shall include in the sphere of its activities all matters pertaining to animal industry, and with the object of improving the indigenous stock, importations of pedigree cattle have already been commenced, and the formation of a herd destined to produce grade bulls for distribution throughout the native areas is already an accomplished fact.

Circulars in Swahili describing the correct manner of skinning, drying and preparing hides have been widely distributed throughout all districts. These circulars were compiled on advice received from manufacturers in Britain and America and much assistance in this respect was obtained from local merchants.

The most important factor which affects the quality of the hides and skins exported is undoubtedly the price which happens to be ruling the market at the moment. When the price is high, the skins and hides are collected promptly and are not held up in small stores or in the native huts, with the result that they reach the coast comparatively fresh and undamaged, and are promptly baled; the ingress of insects is thus prevented, and the bales are shipped in good condition.

Certain firms are contemplating the erection of tanks in which to arsenate the hides and skins prior to export. The shade-drying of hides is also receiving attention, and successful endeavours are being made in some districts to induce natives to stretch hides and skins on poles in preference to the usual method of pegging on the ground.

Mr. W. Kennedy: While admitting that Mr. McCall's statements as to the numbers of cattle in the respective territories may be correct according to published statistics, I would state that the number of cattle in Kenya has only been very roughly estimated, and I am of the opinion that if a proper census were taken it would be found that we possess an equal if not greater number than Tanganyika Territory. In connection with the feeding of animals prior to slaughter, it has been proved in the Argentine that cattle reared on the natural grassess are not suitable for freezing and chilling purnoses, and on the big ranches it has been necessary to plant up large areas with lucerne on which the cattle are finished off prior to slaughter.

Mr. F. J. McCall: Arising out of Mr. Kennedy's estimate of the number of cattle in Kenya I have recently traversed many of our most important stock districts in Tanganyika. It is nearly two years since our census was made, and I feel confident that nearly 40% of the cattle in the herds today are under the age of two years.

When we consider the extent to which our male stock was depleted during the war it is possible to throw light on the situation. An analysis of herds in many districts of Tanganyika today reveals a relatively low proportion of male stock. The percentage working out at approximately 6% bulls, 3% of large oxen, about 40% of breeding stock; that includes female stock actually breeding and pregnant heifers. The remainder of the herds are largely composed of calves, and young heifers, as the young bullocks between a year and 20 months old are slaughtered to a considerable extent. For this reason I am confident that when our next census is taken the relative position will show an increase with regard to the former census and that Tanganyika will still maintain its lead.

The Chairman: To demonstrate the interest which the Government of Uganda is taking in this subject, it should be mentioned that some £10,000 was allocated from the Development Loan for the purpose of starting a stock farm. Up to the present time the introduction of cattle, buffaloes, and the various goats and sheep has been made, but as can be imagined the development of a farm is a matter for some years. Surveys have been made with a view to picking out a good spot and it is hoped the Government will agree to the area chosen.

In Uganda, the present price of cattle is somewhat in excess of what it is in the adjacent territories, owing largely to the confidence natives have in stock, for they now know that cattle mean money, and are utilising them as a bank. In fact the demand for cattle in Uganda at the present time is very great and were an open trade through Lake Victoria available, that country would be able to assist Mr. McCall in removing cattle from some of his overstocked areas.

Naturally, the prosperity of the Uganda native is largely due to the money he derives from his cotton which, although small in comparison with that of Egypt and the Sudan, is to that country a very material asset, and in this connection it has been pointed out forcibly, that further production of cotton there cannot be expected to occur. The natives have reached their limit owing to the absence of a system of work-oxen for plough and transport. With the introduction of cheap transport a much greater area can be put under cultivation. Once again cattle react upon the whole economic and social life of the people.

I would like to supplement the remarks I made this morning with regard to the feeding of stock for the butcher. As Mr. Kennedy correctly pointed out the stock of South America are not raised exclusively on natural pastures. There is very little doubt that the natural pastures of East Africa are eminently suited for grazing whilst in the highlands the Colonists can produce at a very low cost all the essential supplementary food-stuffs that may be required for fattening purposes.

RESOLUTION.

MEAT AND MEAT PRODUCTS.

HIDES AND SKINS.

This Conference records its opinion that the available assets of stock in Native Africa are not fully exploited in the interests of owners, and being impressed with the development of the meat and allied industries in Madagascar, considers that similar action should be taken elsewhere to foster the utilisation of stock products not now marketed: it is further convinced that the added wealth so derived will most fully warrant the necessary expenditure entailed.

(F) STOCK ECONOMICS.

(4) Animal Transport.

Mr. F. J. McCALL: (Chief Veterinary Officer, Tanganyika Territory). As undoubtedly all the East African Delegates present here today realise, transport is one of the most important economical problems into which animal husbandry enters.

To observe the efforts of large numbers of able-bodied people throughout the country endeavouring to inadequately cultivate small patches of land by hand must be a source of dissatisfaction to true economists, especially when one reflects how those energies might be conducted along more productive channels with greater benefit to the community as a whole.

Head porterage would not be seriously considered in any country than Africa. Motor vans have replaced human carriers in many districts, but we all know that the expense attendant upon such a form of mechanical transport precludes its employment in a great number of the best districts of our respective countries.

It is admitted, that in many areas the presence of tsetse belts precludes the use of animal transport, but again there are thousands of miles of suitable roads and tracks well adapted to light bullock carts and it is our duty to endeavour to encourage natives to make greater use of such facilities. Particularly is the introduction of the two-wheeled light ox-cart and the light draught plough advocated Today in many areas the prevalence of tsetse consitutes the dominant problem of native life awaiting solution because the danger of sleeping sickness cannot be overestimated. By no other known means can glossinae be so efficiently controlled as by extirpation of the bush, if, as is done in other countries throughout the world, the ox were inspanned to the plough, and the population, instead of spending their time hand digging their shambas, were persuaded to chop out the bush and extend the open country, much of this cause for anxiety would be removed. The drawback to progress in perhaps not so much lack of initiative on the part of natives as inability to construct wheels or build carts. I think therefore, that it would be well if we urge on our respective Governments the advisability of including carpentry in their educational programme to an even greater extent than hitherto. Cheap carts, cheap oxen and cheap means of feeding these, will in my opinion, form the solution to the transport problem in these areas.

Mr. J. A. GRIFFITHS: What provision do you make in your Colonies for outspanning stations along the main roads where ox transport is used?

Mr. F. J. McCALL: In Tanganyika the necessity has scarcely arisen, except in the case of a few main roads and along these outspans have been demarcated.

Mr. W. KENNEDY: In most of our native reserves ox transport is largely used, but the oxen and waggons or carts are the property of transport riders or traders. The native himself has not been taught to use this form of transport himself.

Mr. J. A. GRIFFITHS: Is there any definite acreage allowed for outspans?

Mr. W. KENNEDY: No hard and fast rules are laid down.

THE CHAIRMAN: I am very glad that Mr. McCall has ventilated this subject of animal transport, and the greater use, by the small producer, of animal cultivation. I would welcome discussion on the average cost of running ox transport per ton mile which has been roughly computed at 6d per ton mile.

Mr. J. A. GRIFFITHS: In Nyasaland, the charge is 8d to 9d per ton mile.

Mr. H. E. HORNBY: In Portuguese East Africa about 1913 the charge was 9d per ton mile, when running through light "fly" areas.

THE CHAIRMAN: In Uganda there are already in existence ploughing schools. Today oxen and natives are sent for training and the Government encourages the use of small ploughs. It is hoped at an early date to institute similar organisations in connection with wheeled transport, where the training and handling of oxen on the roads and the shoeing of oxen where necessary, will be taught.

Mr. H. E. HORNBY: The practice of guiding oxen by means of nose ropes is widely adopted by Indians and natives in Tanganyika. Should not this be illegal?

M. H. H. BRASSEY-EDWARDS: There is existing legislation in Nairobi forbidding the use of nose-ropes. This, however, applies only to the township.

Mr. J. A. GRIFFITHS: Has anybody any experience of shoeing oxen?

THE CHAIRMAIN.—Most of the oxen in Zanzibar are shod, all the Government oxen are.

Mr. H. H. BRASSEY-EDWARDS: The oxen belonging to the Nairobi Municipality are shod.

RESOLUTION.

ANIMAL TRANSPORT.

This Conference is of opinion that in many parts of Africa ox transport and ox labour are cheaper than any other form, and with a view to encouraging their adoption it urges that interested Governments offer adequate facilities for establishing training centres where ox driving and shoeing, cart construction, and ploughing can be taught.

FIFTH PAN-AFRICAN VETERINARY CONFERENCE, 1923.

RESOLUTIONS PASSED BY THE CONFERENCE.

RINDERPEST.

(1) This Conference considers that Rinderpest can be controlled and eventually eradicated in the areas wherein it now exists provided that the necessary facilities are made available. But to accomplish this, it is essential that Veterinary measures be accorded the very fullest support and active co-operation from all Government Officers.

BOVINE CONTAGIOUS PLEURO-PNEUMONIA.

(2) This Conference considers that Bovine Contagious Pleuro-pneumonia can be controlled and eventually eradicated in the areas wherein it now exists provided that the necessary facilities are made available.

But to accomplish this, it is essential that Veterinary measures be accorded the very fullest support and active co-operation from all Government Officers.

EAST COAST FEVER, TICK DESTRUCTION, AND TICK-BORNE DISEASES.

(3) This Conference is of the opinion that a Pan-African Enquiry should be instituted in regard to East Coast Fever and allied infections, especially with a view to ascertaining the nature and cause of the immunity enjoyed.

(4) This Conference considers that efficient tick destruction will eradicate East Coast Fever, and other tick borne diseases.

(5) This Conference is of the opinion that East Coast Fever can be eradicated by regular dipping, under proper supervision, in the standard strength of arsenical solutions for dipping at intervals of three or five days.

(6) This Conference considers it is desirable to undertake further research into the possibility of using a non-poisonous dipping solution for the prevention of tick infestation.

TRYPANOSOMIASIS AND TSETSE BIONOMICS.

(7) This Conference would emphasise the importance of Trypanosomiasis throughout Africa and the large areas rendered unsuitable for stock by its prevalence. It is of opinion that further research is required on the bionomics of tsetse flies and of methods of restricting and eradicating them.

(8) This Conference urges that as in some areas the so-called mechanical transmission by agency other than tsetse flies appears to be of great importance further investigations are required.

PLANT POISONING.

(9) This Conference records its appreciation of the work in South Africa upon poisonous plants, and considers that a Pan-African enquiry should be instituted into the distribution and effects of plants shown elsewhere to possess toxic properties.

PATHOLOGICAL RESEARCH.

(10) This Conference is of opinion that Veterinary Officers attached to a Government Service should undergo a period of training at a Laboratory for a period of not less than six months during their probationary period, and again as frequently as possible during their service, in order that the affinity between field and laboratory observations may be closer.

WATER FACILITIES FOR LIVE STOCK.

(11) This Conference is of opinion that funds should be allocated annually, in countries where considered necessary, for the provision of better watering facilities for live stock. This is desirable in order to control undue movement of animals and the consequent spread of disease.

GENERAL RESOLUTIONS.

(12) That it is desirable to appoint a General Committee, representative of African territories, in order to co-ordinate the work of future Conferences:—

Union	Principal Veterinay Officer and Director of Veterinary Research.
Madagascar	Chef de Service Veterinaire.
Portuguese East Africa ...	Chief Veterinary Officer, Lourenco Marques.
Tanganyika Territory ...	Chief Veterinary Officer.
Nyasaland	Chief Veterinary Officer.
Uganda	Chief Veterinary Officer.
Sudan	Director of Veterinary Services.
Rhodesia, South	Chief Veterinary Officer.
Rhodesia, North	Chief Veterinary Officer.
Kenya	Chief Veterinary Officer.
Bechuanaland	Chief Veterinary Officer.
Basutoland	Chief Veterinary Officer.
Swaziland	Chief Veterinary Officer.

With the past Chairman as President.

(13) That an Executive Committee be appointed at each Conference consisting of three members, to ensure continuity between Conferences.

The Committee now nominated to consist of: Sir Arnold Theiler, The Chairman and a delegate of the country next to be visited.

(14) This Conference is of opinion that the Executive Committee of the Pan-African Veterinary Conference should communicate with the Veterinary Departments of interested Territories with a view to closer co-operation.

(15) That enquiries designated "Pan-African" in these resolutions shall devolve upon the country nominated and agreeable thereto. The initiation of the steps necessary to give effect to these resolutions shall lie with the Executive Committee to be appointed at each Pan-African Conference.

(16) That this Conference expresses the hope that next Pan-African Conference be held in Madagascar in 1926 or 1927. In the event of this not being possible, the selection of venue shall lie with the General Committee by vote.

The following resolutions were passed after the departure of Dr. P. R. Viljoen, Mr. W. M. Power, Dr. J. B. Botelho and Major P. Tissie.

NATIVE ECONOMICS.

(17) This Conference records its opinion that the available assets of stock in Native Africa are not fully exploited in the interests of owners, and being impressed with the development of the meat and allied industries in Madagascar, considers that similar action should be taken elsewhere to foster the utilisation of stock products not now marketed: it is further convinced that the added wealth so derived will most fully warrant the necessary expenditure entailed.

ANIMAL TRANSPORT.

(18) This Conference is of opinion that in many parts of Africa, ox transport and ox labour are cheaper than any other form, and, with a view to encouraging their adoption, it urges that interested Governments offer adequate facilities for establishing training centres where ox driving and shoeing, cart construction, and ploughing can be taught.

RABIES.

(19) That in the opinion of this Conference the disease discussed as Rabies shall continue to be regarded as true Rabies, and it draws the attention of the respective Governments to the inadequate facilities in many parts available for the Pasteurian treatment of patients.

CONCLUDING ADDRESSES.

Mr. W. M. Power: Mr. Chairman, and Gentlemen, I am sorry that it is necessary for the South African Delegates to leave the Conference before it has completed its final sittings, but under the circumstances I have no alternative but to ask your permission to depart.

There are courtesies with which we wish to be associated before leaving, though it is not usual to propose them before the final sitting, but in this case I hope you will give me the opportunity of proposing a vote of thanks to the Government of this Colony for the hospitality we have received from them since we arrived in the country, and for the facilities afforded us for carrying out the Conference successfully. It is clear to us that since we arrived here we had met a sympathetic Government and sympathetic officials, and that everybody with whom we have come in contact have been in sympathy with our work. I interpret this also as a good indication of the standing of our own colleagues in this Colony. I would therefore ask you to convey our thanks and appreciation to the Government of this Colony.

Dr. J. B. Botelho: I concur with what Mr. Power has said regarding the cordial hospitality the Delegates have received from this Government. If at any time any of you happen to come through Lourenco Marques I shall be very pleased to do all in my power to make your stay there agreeable.

Major Paul Tissie: Mr. Chairman and Gentlemen, I wish to express my heartfelt thanks for the hospitality extended to me during my stay in Kenya. I only hope that many of you will visit Madagascar soon to give me an opportunity of showing my gratitude.

A big Exhibition is to take place in August and September next and I should be pleased to welcome any of you who would care to attend. I may say that this would be an excellent opportunity of seeing Madagascar under ideal circumstances. The present Conference, of which I had the honour of being a member, has dealt with important diseases which fortunately do not exist in Madagascar. I have given you my views on those conditions which affect stock in our country. I hope that the Conference will prove beneficial to ourselves and our respective Governments, and that by adopting the resolutions passed at this Conference stock diseases will be to a large extent eliminated.

Dr. P. R. Viljoen: At the commencement of this Conference I had the honour to propose Mr. Montgomery to be our Chairman. It is a great pleasure to me to take this opportunity of proposing a very hearty vote of thanks to him for the excellent manner in which he has presided. When he was proposed to the Chair, I did not say anything in support of my proposal because it was only a formal matter, however, I should like to say a few words now.

I think everybody present here is unanimous on the excellent way in which Mr. Montgomery has taken charge of our deliberations. He has been responsible to a large extent for the very fine spirit which has prevailed at all our discussions, and for the very high level in which our deliberations have been conducted. To him we can ascribe to a large extent the enormous amount of work which we have been able to get through. That this work is of enormous size can be seen by the very large collection of documents. To him also, we have to express our thanks for a very pleasant time which we have enjoyed in East Africa.

As you know, Mr. Montgomery is also well known in South Africa. We all know him and admire his outstanding professional qualities. He has done some very good work in South Africa, and to illustrate this I can only mention that he gave us great assistance in getting the Veterinary faculty established in the Union. He also gave us his assistance in outlining the curriculum of studies for that faculty.

Whilst speaking of the Veterinary Faculty of the Union I wish to take this opportunity Mr. Chairman to extend a very hearty invitation to all African Territories to visit Onderstepoort, and to make use of the facilities which are available there, for both pre- and post graduate studies. I sincerely hope that the inhabitants of the different African Territories will send their sons to the Union to graduate in Veterinary Science.

It is unnecessary for me to say anything with regard to the standard of Veterinary Education in South Africa. I need only mention that Sir Arnold Theiler stands at the head of this faculty, because his world-wide reputation for hard and thorough work and his great organising powers, are sufficient guarantee that the high standard of Veterinary Education will be maintained. Some of you present here have been to Onderstepoort for post-graduate work. Unfortunately when you were there no organised courses of instruction existed, but it is hoped to establish proper post-graduate courses of a thorough practical and scientific character.

In proposing the vote of thanks to our Chairman, I will conclude by wishing him every success and prosperity in his new sphere of work in this country.

Captain B. A. Jarvis, R.A.V.C. I have great pleasure in seconding the vote of thanks, and also have very great pleasure in taking this opportunity of associating myself with the remarks Dr. Viljoen has just made. I am sure we all agree that this Conference has been a great success and that some of the most useful results have been obtained. The hospitality extended to us by members of the Veterinary Service in Nairobi has been unbounded, and I should also like to take this opportunity of expressing a vote of thanks to the Secretary and Committee of the Nairobi Club for the way in which they have extended their hospitality to us.

Mr. F. J. McCall: It is with the greatest feelings of admiration and respect that I rise to refer to the work of our Secretary. The exact magnitude of his task none of us can fully realise, but we do know the excellent manner in which he has fulfilled it. I feel sure that his work will be appreciated by all stockowners and by all scientific workers in the African continent when they obtain the report of this Conference. I therefore have great pleasure in proposing a vote of thanks to our Secretary.

Mr. J. A. Griffiths: I would like to second that.

The Chairman.—If I may be allowed the opportunity of returning thanks to Dr. Viljoen for his kind remarks I would also like to express the great regret of all the other delegates and myself at the early departure of those who are leaving us today. We have still a considerable amount of work to do of value and importance in which their deliberations would be of extreme value. I can only extend to them our wish that we shall foregather again, conceivably in Madagascar within the next four years, and until then to wish them " bon voyage " and continued prosperity in their countries.

CHAIRMAN'S CONCLUDING SPEECH.

Gentlemen.—I think we all feel regret as well as relief that this Conference is now concluding. Since the 6th instant we have only escaped from our sessions on Sundays: we sat late each evening and on Saturday afternoon, and our nights were devoted to proof correction of the previous day's sittings. But our regret is considerable that time did not allow of more detailed consideration of the subjects discussed, nor for the inclusion of many others which would well justify debate in a Pan-African Conference. But if we can make progress on the subjects which were debated at length more particularly those considered worthy of a resolution, it will be an added pleasure at the next Conference to listen also to tales of success.

At no gathering which it has been my lot to attend in the past have the proceedings taken place with such an absence of parochialism and petty feeling. Not once was that spirit manifested, and every Delegate gave of his best and all for the benefit of others. This unanimity of action as of opinion augurs well for a closer co-operation between African Territories in matters Veterinary. I need only refer to those resolutions suggesting a Pan-African Enquiry into horse-sickness, East Coast fever and poisonous plants.

Most territories are too small or too poor by themselves alone, to do anything serious in any one of these lines: but each can do something in a possibly humble but still in a particular direction, and the sum total of these works will form a tangible result not possible in any other way. No longer can it be said that we as Veterinarians are so obsessed with the importance of controlling disease that we missed the true perspective. I cannot agree that as a body we were ever guilty of such narrow-mindedness, nor again of the contrary criticism that we are too ethereal, too optimistic, for practical politics.

It is another of the outstanding features of this Conference that at no time was it forgotten that Veterinary operations are only justified at a cost below the value of the benefits received, and that, however desirable certain results might be the economic aspect must be considered first. The time devoted to the consideration of meat, milk products, hides and skins, as affecting the majority of stock in the respective territories was well spent as it is to the success of those, at present undeveloped in Eastern Africa, that we must turn for the funds requisite to carry out the other works we have in view.

The present value of exports derived from 7,000,000 cattle in Eastern Africa averages £283,000 per annum. It is calculated that by developing the hide and ghee production this could be raised to just under the million pounds while with the inception of a meat industry taking 4% of the countries' cattle each year a further £687,000 would be obtaned.

Attention too was paid to the importance of ox transport upon the development of which young countries most largely depend, especially at the present time when capital for railway and motor road construction is expensive. In addition to saving human labour, it provides remunerative employment for surplus oxen, both for work in the field and on the road, in which latter capacity it retains by a long lead the premier place for cheapness in many vast areas.

No, Gentlemen, there has been no small-mindedness at this Conference, and animals as a whole have been faithfully discussed. I wish to thank Dr. Viljoen, and other speakers for their kind expressions towards myself as Chairman. By the harmony and co-operation pervading my duties were light, and they were further relieved by the most efficient secretary and his staff. I would pay a special compliment to the stenographers and typists, who by working late and long, kept pace with our proceedings.

It has been a great pleasure to delegates to receive from the Kenya Government the encouragement and the hospitality accorded and we owe Sir Charles Bowring especial thanks for his graciousness and many kindnesses.

We all hope that Madagascar may be able to extend an invitation for the next Conference in 1926 or 1927: previous gatherings have all been on British soil, and, for this reason, as well as on account of the extensive Veterinary operations carried on there, a visit to the French island would be a great pleasure.

Gentlemen, in again thanking you for your support I now formally declare the Fifth Pan-African Veterinary Conference closed.

APPENDIX.

COLONY AND PROTECTORATE OF KENYA.

S. 20093/4

PAN-AFRICAN VETERINARY CONFERENCE, 1923.

I have the honour to intimate that the Secretary of State for the Colonies, has approved my proposal to hold the next Pan-African Veterinary Conference at Nairobi, Kenya Colony, in April, 1923, I trust that your Government will be represented.

2. Previous Pan-African Veterinary Conferences have been held as follows:— At Bloemfontein 1904; at Cape Town 1907; at Pretoria 1909; and at Bulawayo, Rhodesia, 1913; it was decided at Bulawayo that the next Conference should be held in 1916 in Eastern Africa. Owing to the war no earlier date than that now announced could be arranged.

3. This invitation is being sent to the following countries viz: Egypt, Sudan, Italian Somaliland, French Congo, Belgian Congo, Belgian Ruanda, Portuguese East Africa, Madagascar, Nyasaland, Southern and Northern Rhodesia, Bechuanaland, Swaziland, Basutoland, Portuguese West Africa, the Union of South Africa, Nigeria, Gold Coast and Gambia. The Governments of the Uganda Protectorate, Zanzibar and Tanganyika Territory have already signified their intention to send delegates. The Ministry of Agriculture, London, is being invited by the Secretary of State for the Colonies to send a representative.

4. It has been customary in the past to invite each Government to send two Delegates, viz., the Chief Veterinary Officer and the Chief Officer of the Laboratory or Research Section, but it is hoped that for this Conference the Veterinary Officer in charge of cattle Breeding or other Economic and Industrial sections may also be delegated. The selection and number of Delegates must of course rest with each Government, but I would express the hope that the Administrative, Scientific and Industrial sides of Veterinary activity will be fully represented.

5. It is proposed that the Chairman of the Conference should be Mr. R. E. Montgomery, Veterinary Adviser for Uganda, Kenya and Tanganyika Territory. Mr. Montgomery has served as Director of Veterinary Research to the Union of South Africa and has wide personal experience of South African and Rhodesian conditions.

6. No formal agenda has been arranged, and it is proposed that Delegates at their first meeting should draw up a programme for consideration and debate. The following subjects, which naturally apply more especially to East African conditions will, however, serve as an indication of the topics considered suitable for discussion.

I.—STOCK CONSERVATION.

(A) Pathological Research.

1. Dominant subjects in each country.
2. Co-ordination preventing duplication.
3. Exchange of Reports and memoranda.

(B) Production and exchange of Vaccine and Sera; Costs and Revenue.

(C) Microscopical Diagnosis
Laboratory and District Officers.

(D) Disease Control.

1. Administrative system.
2. Use of native owners for intelligence purposes.
3. Legislation and Punishments.
4. Immunisation.

(E) Major Specific Diseases.

1. Pleuro-pneumonia.
2. Rinderpest.
3. East Coast Fever: Tick Destruction.
4. Trypanosomiasis.
5. Horsesickness.
6. Anthrax.
7. Black Quarter.
8. Gallamziekte.
9. Other tick-borne diseases.

Other diseases of Economic importance.

Plant poisoning.

(F) Grazing and Water Facilities.

Botanical and Entomological Surveys.

II.—Stock Improvement.

1. Eugenics.
2. Selection and Registration of Sires.

III.—Stock Economics.

1. Cattle taxation.
2. Milk products.
3. Ghee production.
4. Meat and meat products.
5. Hides and Skins.
6. Wool and Hair.

7. It is understood that the British India Steam Navigation Company's s.s. "Mashobra" will reach Mombasa from London on April 4th 1923, calling en route at Port Said, Suez, Port Sudan and Aden; and that a ship of the same line is due at Mombasa from Durban approximately on April 3rd. It is therefore proposed that the Conference should commence on Monday, April 9th, and should sit for one week.

8. I shall be glad to be informed, by telegraph if possible, of the names of the Delegates Your Excellency proposes to send in order that suitable accommodation in Nairobi may be reserved. It is understood that payment by each Government of the travelling and other expenses of its Delegates will be in accordance with precedent. I entertain high hopes of the good results which this Conference will achieve if it is attended by representative Delegates from each Government.

R. T. CORYNDON,
Governor.

Government House,
Nairobi,
Kenya Colony,
27th December, 1922

PAN-AFRICAN VETERINARY CONFERENCE, 5th,
NAIROBI, 1933.

Report of the proceedings... 1934.